AP - FECM

GROWING HIGHER FORESTRY EDUCATION IN A CHANGING WORLD

Analysis of Higher Forestry Education in the Asia-Pacific Region

APFNet

THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Forestry

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FOREWORD

Forestry has been shaped by factors both within and outside the forest sector over the past several decades. Society has realized the role of forests in providing multiple products and services instead of a sole focus on timber resources. The public has been more aware of the inter-linkages between forests and environment and economic growth. Challenges like illegal logging and climate change have led to forestry issues being considered in an integrated and coordinated way to meet sustainable development goals. These changes require cultivating a new generation of foresters equipped with knowledge and tools to address climate change, reduce deforestation, and develop and implement effective policy.

Higher (tertiary) forestry education is an important tool in this process. Realizing this critical role, the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) proposed the Asia-Pacific Forestry Education Coordination Mechanism (AP-FECM) at the First Forestry College Deans Meeting in 2010 and formally launched it at the second meeting of this group in 2011. The Mechanism aims to promote and advance higher forestry education in the Asia-Pacific region by strengthening communication and encouraging collaboration among member universities. Since its inception, APFNet has supported AP-FECM to enhance the understanding of regional issues in higher forestry education. This included identifying key strengths and weaknesses, and prioritizing a set of actions to improve curriculum development for sustainable forest management (SFM). A

collaborative platform was created by AP-FECM to promote network formation, scholarly information sharing, opportunities for joint educational programmes, and research among forestry-related tertiary education institutions in the AP Region. AP-FECM has also increased access to education opportunities by developing free online courses focused on SFM, which can be used to educate students and mid-career practitioners. These courses were proposed at the 2013 Forestry College Deans Meeting in New Zealand. More recently, AP-FECM has been working to strengthen relationships, and advance projects and joint educational programmes. Plans have been made to develop another series of accessible education courses that will be available on a massive open online course (MOOC) platform.

Higher forestry education has evolved to adapt to various changes across the globe, from a resource-centered approach to a more integrated approach. Forestry-related programs are becoming holistic and cross disciplinary, linking to environmental science, including forest resources and values in addition to timber, and responding to international policy development. There are 190 universities in the Asia-Pacific region offering more than 510 forestry-related programs, with more than 124,000 students enrolled. Quite a few forestry-related programs have been recently developed, such as urban forestry, ecotourism and environmental services, parks, recreation and tourism, and geomatics for environmental management. Higher forestry education also varies greatly among regional economies that face different and common challenges.

In order to fully understand the status quo and potential for future forestry education development in the Asia-Pacific region, APFNet supported AP-FECM to conduct a Forestry Education Survey in 2016 to collect information on different indicators of forestry education in the 2005-2015 period. Twenty-four-member universities from 14 regional economies participated in the survey.

This publication, building on the findings of the survey, reviews the status of higher forestry education in the Asia-Pacific region, summarizes the efforts by universities to address emerging challenges, and recommends solutions for both universities and AP-FECM to further improve the effort. In addition, it presents 11 case studies

contributed by member universities on detailed analysis of forestry education in their home economies and efforts to address challenges faced.

This report targets professionals and researchers in forestry-related higher education institutes, but also practitioners in forestry and related sectors who would like to understand the development and trend of higher forestry education. While this does not represent a comprehensive picture of higher forestry education in the Asia Pacific Region, the report is the first of its kind, and will provide a baseline against which progress can be measured.

Signature	Signature
Lu De Executive Director Asia-Pacific Network for Sustainable Forest Management and Rehabilitation	John Innes Chair, Asia Pacific Forestry Education Coordination Mechanism Dean and Professor, Faculty of Forestry, University of British Columbia

ACRONYM AND ABBREVIATIONS LIST

*Universities with two-worded names such as University of Canterbury and University of Melbourne will not be abbreviated for clarity. For example, Kyoto University and Kasetsart University are both informally known as KU and hence shall be written out in full to avoid confusion. Longer university names (three or more words) will be abbreviated in this report.

As the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) was proposed at the Asia-Pacific Economic Cooperation (APEC), APFNet publications follow APEC terminology. Members of APFNet should be referred to as “economy” or “member economy” / “economies” or “member economies”, except in the case of international and non-governmental organizations, academic institutions and the private sector.

AP	Asia Pacific
AP-FECM	Asia-Pacific Forestry Education Coordination Mechanism
AUFSC	Association of University Forestry Schools of Canada
BFU	Beijing Forestry University, China
CARDI	Cambodian Agricultural Research and Development Institute
CCU	Chinese Culture University, Chinese Taipei
CSUK	Chea Sim University of Kamchay Mear, Cambodia

ERA	Royal School of Administration, Cambodia
GFIS	Global Forest Information Service
IFESCU	Institute of Forestry and Environmental Sciences, University of Chittagong, Bangladesh
IPB	Bogor Agricultural University, Indonesia
ITC	Institute of Technology of Cambodia
ITI	Industrial Technical Institute Cambodia
MUC	Universite de Mean Chey, Cambodia
NCYUF	National Chiayi University Forestry, Chinese Taipei
NCYUW	National Chiayi University Wood, Chinese Taipei
NFEC	National Forestry Education Consortium Mongolia
NIB	National Institute of Business of Cambodia
NIE	National Institute of Education of Cambodia
NIU	National Ilan University, Chinese Taipei
NPUST	National Pingtung University of Science and Technology, Chinese Taipei
NPIC	National Polytechnic Institute of Cambodia
NTTI	National Technical Training Institute, Cambodia
NTU	National Taiwan University, Chinese Taipei
NUM	National University of Management, Cambodia
PNCA	Prek Leap National College of Agriculture, Cambodia
PPI	Preah Kossomak Polytechnic Institute, Cambodia
RAC	Royal Academy of Cambodia
RUA	Royal University of Agriculture Cambodia

RUFA	Royal University of Fine Arts Cambodia
RULE	Royal University of Law and Economics Cambodia
RUPP	Royal University of Phnom Penh, Cambodia
SFM	Sustainable Forest Management
SDG	Sustainable Development Goal
SRU	Svay Rieng University Cambodia
UBB	University of Battambang, Cambodia
UBC	University of British Columbia, Canada
UHS	University of Health Sciences Cambodia
UMK	Universiti Malaysia Kelantan, Malaysia
UNB	University of New Brunswick, Canada
UNBC	University of Northern British Columbia, Canada
UPLB	University of the Philippines Los Banõs, the Philippines
UPM	Universiti Putra Malaysia, Malaysia
USA (West)	California Polytechnic State University San Luis Obispo, USA
	Humboldt State University, USA
	Oregon State University, USA
	University of Alaska Fairbanks, USA
	University of California Berkeley, USA
	University of Washington, USA
VNUF	Vietnam National University of Forestry

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Special thanks to the experts from each of the universities who worked to compile all the information in a timely manner and the authors and editors that helped develop this report.

The following participants responded to the Forestry Education Survey.

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Beijing Forestry University, China

Bogor Agricultural University, Indonesia

Chinese Cultural University, Chinese Taipei

Chittagong University, Bangladesh

Kasetsart University, Thailand

Kyoto University, Japan

National Chiayi University, Chinese Taipei

National Chung Hsing University, Chinese Taipei

National Forestry Education Consortium (NFEC), Mongolia

- International University of Ulaanbaatar
- Mongolian University of Life Sciences
- Mongolian University of Life Sciences Darkhan
- Mongolian University of Science and Technology
- National University of Mongolia

National Pingtung University, Chinese Taipei

National Taiwan University, Chinese Taipei

Royal University of Agriculture, Cambodia

University of Canterbury, New Zealand

University of British Columbia, Canada

University of Melbourne, Australia

University of the Philippines Los Banõs, Philippines

Universiti Malaysia Kelantan, Malaysia

Universiti Putra Malaysia, Malaysia

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CONTENTS

Chapter 3: Current Higher Forestry Education Trends

Chapter 4: Forestry Education Efforts in the AP Region

Chapter 5: Summary and Recommendations

Appendix 1

Appendix 2

Appendix 3

Appendix 4

CHAPTER 1

FORESTS AND HIGHER FORESTRY EDUCATION IN A CHANGING WORLD

Forests are highly influenced by social, political, economic, and ecological factors. Pressures from these factors can lead to changes in economic stability, ecological health, social well-being, and societal demands. Such changes can affect policy-making and political stability, which in turn have notable impacts on the overall state of the world's forests.

1.1 FACTORS AFFECTING FORESTS AND HIGHER FORESTRY EDUCATION

Higher forestry education has evolved to inform students of the various challenges to forests including climate change, deforestation, illegal logging, policy development and implementation, and social attitudes towards the forest industry. These challenges were reported in the Forestry Education Survey and via associated literature reviews. They work in combination to influence the direct factors that shape forests and forestry education.

Forestry education has been changing to address some of these challenges and incorporate solutions. Participants in the Forestry Education Survey reported that their institutions are working to educate more individuals to be able to address the challenges caused by global changes. Implementing sustainable forest management (SFM) practices has been a challenge in the AP Region due to the lack of educated practitioners. However, attempts are now being made to promote higher forest education in the region, especially at a graduate level, to increase the number of well-educated forestry professionals.

1.1.1 CHALLENGES INFLUENCING FORESTS AND FORESTRY EDUCATION

Many factors affect forests, including the changing climate, the rate of deforestation and illegal logging, changing public attitudes towards forestry, and international policies.

Increased anthropogenic greenhouse gas emissions are leading to increased global temperatures (IPCC, 2014). This has direct effects on the forestry industry by changing the ecological structure and dynamics of the forest. Survey participants reported that forestry curricula must adequately cover climate change and global ecological changes.

Deforestation is contributing to increased greenhouse gas emissions, as it accounts for roughly 10 percent of global emissions of carbon dioxide into the atmosphere (IPCC, 2014). Deforestation is occurring at higher rates to accommodate the needs of economic transitions in developing economies. These demands are having negative impacts on the overall health of forests around the globe. If the high rates of deforestation in the AP Region continue, there will be increases in forest fires, species extinctions, and reductions in productivity (Huq et al., 2011). These risks, and possible mitigation strategies, are now incorporated into most forestry curricula in the AP Region.

Individuals are often involved in illegal logging activities to provide for their families and communities, especially in economically disadvantaged areas. For example, an estimated 76-80% of logging that took place in Indonesia in 2004 was illegally conducted, 90 percent of logging carried out in Papua New Guinea was illegal (Goncalves et al., 2012). While these statistics have declined recently in the AP Region due to implementing SFM laws and regulations, illegal logging still accounts for an estimated 40-55% of the harvesting conducted in the AP Region in 2008 (Goncalves et al., 2012). Implementing effective policies to address this issue is very important; however, many policy efforts have failed to eliminate rapid deforestation and illegal logging. Forestry practitioners must be able to understand the challenges of illegal logging to implement policy effectively. This requires understanding the social and economic factors that underlie illegal logging. The survey responses indicated that many socio-economic factors that influence forests and the forest industry are included in forestry curricula.

Public perceptions and attitudes towards forestry and its traditional practices are said to have an influence on enrolment into higher forestry education programmes

throughout the region. Over the last few decades, many members of the public view the forestry industry as destructive, with little regard for environmental protection and conservation of the forest for future generations. While the forest environment will continue to change and adapt to external stresses and factors, resource users must also adapt. Solutions are being implemented to limit and mitigate climate change, deforestation, and illegal logging through enhanced education as well as policy development and implementation.

Policies put in place by regional governments guide the practices carried out in the field by forestry professionals. Without relevant policy development and implementation, unsustainable practices will continue. Higher forestry education strives to provide future policy makers with the knowledge and tools to develop appropriate policy that is place-based, contains community input, and incorporates economic, social, and ecological well-being. It is also important to effectively implement and govern existing policies. For example, some policies that take drastic measures to prevent illegal logging have been developed but have not been implemented effectively because of a lack of local governance and understanding. Consequently, these policies are ineffectual.

1.1.2 GLOBAL AND REGIONAL SOLUTIONS IN A CHANGING WORLD

Climate change is arguably one of the most significant challenges faced by humans today. Impacts of climate change are noticeable across the globe, including impacts on forests. Temperatures are increasing, precipitation amounts are changing, and sea level is rising; all of these factors affect forests in the AP Region (Krzyzanowski, 2013).

Global efforts are being made to adapt and combat the impacts of human-induced climate change. The 2015 Paris Agreement urged all participating parties to recognize the need for progressive response to the growing threats of climate change (UNFCCC, 2015). Land use, land-use change, and forestry activities have been added to several economies' statements as one means to accomplish emission

reductions and carbon sequestration to meet the given target. Prior to the Paris Agreement, the 1994 Kyoto Protocol directed participating economies to reduce greenhouse gas emissions by means of the Clean Development Mechanism (CDM) and Emission Trade (ET) (Olsson et al., 2015). Mechanisms such as these allowed for conservation of forested areas to sequester carbon dioxide emissions.

To meet the Paris Agreement's two degrees warming limit relative to pre-industrial records, education on climate change mitigation through forestry practice is necessary. Each economy is responsible for producing a Nationally Determined Contribution (NDC), formally known as an Intended Nationally Determined Contributions (INDC), as part of the terms of the Paris Agreement. Of the 162 Parties that provided INDC submissions, 36 were from AP Region (APFC, 2016). Forestry was mentioned in the NDCs in regards to the reaffirmation of existing plans for action on REDD+, as well as afforestation and reforestation tactics (APFC, 2016). The Paris Agreement will have many impacts on the forests of the AP Region. NDCs will become key guiding documents for future planning on climate change adaptation strategies and mitigation plans for the implementation of sustainable forest management (APFC, 2016). Mitigation actions through regional efforts to strengthen forest ecosystems can offer a range of additional co-benefits to enhance biodiversity and ecosystem services to improve community resilience, alleviate poverty, and strengthen food security (APFC, 2016).

SFM will aid in fulfilling many of the NDCs set by economies in the AP Region. Higher forestry education can create experts that can implement SFM practices; however, such solutions only can be achieved by investing in human resources and educating the public on the need for SFM and higher forestry education.

Raising awareness and developing a more in-depth understanding of the challenges facing forestry will enable development of more effective policies, and improve planning and natural resources management. Deforestation and illegal logging commonly occur due to lack of communication and understanding between government and citizens. Strategies to overcome such issues include developing and implementing proper policy.

Government policy on education is working to promote higher levels of forestry education in the AP Region to cultivate human resources to address the shifting needs of the forestry sector. On a global scale, the UN has announced their Sustainable Development Goals (SDGs) for 2030. These goals were established in September 2015 to "end poverty, protect the planet, and ensure prosperity for all". These goals influence and direct policy development to achieve the SDGs, while also achieving each economies' NDC (General Assembly UN, 2015). SFM helps to achieve these goals by creating a more holistic approach to forest resources management. This includes incorporating community management, planning, and involvement, as well as creating practices that work in collaboration with natural cycles and ecological systems, rather than against them. It is important for forest management to incorporate these UN SDGs, as the goals work to redefine the human-nature relationship and formulate sustainable mechanisms to develop the long-term health of the land and the people (CCICED, 2016). These development goals are also important to aid in improve higher forestry education in the region by allowing students to further their forestry education.

It is necessary for higher forestry education to produce graduates who can not only develop effective and appropriate policy, but also properly implement it in communities across the region. For policy to work best, communities must be involved in the development and implementation process. Issues can be mitigated during the implementation process if actions are taken to guarantee that the local people understand why the policy is in the best interest of their land and their future.

The AP Region is experiencing unprecedented losses of natural and secondary forests, and potentially irreversible impacts from climate change. SFM must be implemented to ensure long-term use that is ecologically, socially, and economically responsible for the future. Trained practitioners and knowledgeable policy makers could act to mitigate and combat climate change through sustainable management of the AP forests, decreasing deforestation, and adapting to climate change. To meet the targets put in place by the UNFCCC, the AP Region needs to provide proper

training and education for a new generation of foresters, providing them with the knowledge and tools to adapt to climate change, reduce deforestation, as well as to develop and implement effective policy.

1.1.3 THE EVOLVING ROLE OF HIGHER FORESTRY EDUCATION

Forestry education, like many other forms of higher education, has evolved over the years to keep up with the changes in the forestry sector and accommodate the needs of students and society. Historically, forest education taught a more resource-centered approach to forestry that focused on how humans could manage forested lands, rather than managing humans and their practices on the land. Higher forestry education now works to ensure sustainable management of forests for both people and the environment by cultivating human resources, enhancing scientific research, and raising public awareness surrounding forestry.

Traditional forestry education largely focused on the supply and economic aspects of forestry rather than on a holistic understanding of forest science (Ratnasingram et al., 2013). A shift from 'traditional forestry to more social forestry has been observed over the last few decades (Temu et al., 2005).

Higher forestry education now often includes discussions of community-based management approaches to forestry and holds environmental conservation as a high priority (Temu et al., 2005). Certain approaches have been recognized to lead to inadequate forest management (Ratnasingram et al., 2013). Understanding the existing gaps in the current forestry education system, as well as the necessary upgrades required to face such challenges is vital for ensuring a sustainable future for the forest resources of the AP Region.

Shifting attitudes away from destructive forestry practices is vital to encourage students to enter the field. Solid opportunities for gainful employment are needed, as well as perceived job security. Higher forestry education is not affordable to all, and individuals spending their time and money on education will want to ensure that there will be benefits and rewards after completion of their studies. There is

currently a high demand for well-educated forestry graduates to meet the demands of the AP Region. Communicating that demand to potential students is necessary to attract more and better individuals into the field.

Enhancing graduate (post-baccalaureate) education can work to increase the rate and quality of research and development and boost the economy (Chapman and Chien, 2014). Scientific research is integral for the long-term use and development of regional forests. To develop efficient and effective management strategies, the science underlying forest development and dynamics must be better understood. Research is presently promoted by regional governments as it is said to aid in economic prosperity and growth. However, scientific experts are needed to address the unique needs of each part of the AP Region.

Lastly, higher forestry education should include the benefits of promoting community-based forest management and community involvement. Many rural communities are dependent on the forest and should be educated on how to sustainably harvest materials. Involving local people in the decision-making process, while educating them on sustainable use of forest resources, is essential to developing and implementing effective policy. Raising public awareness on environmental issues engages communities in decision-making processes and empowers them to practice sustainable use on their lands.

Economies within the AP Region need to work to change the public perception of forestry practices from traditional styles to more modern SFM in order to have proper support. In the long run, SFM is not just a benefit to the forestry sector, but a benefit to all economic sectors, and its implementation worldwide would contribute significantly to the achievement of the Sustainable Development Goals.

1.2 THE FORESTRY EDUCATION SURVEY

The Forestry Education Survey was developed to identify the current educational capacity throughout the AP Region. This information is pertinent for the development of capacity-building programmes, projects, and practices, to ensure

they are supported appropriately. The survey was comprised of 3 parts and can be found in Appendix 6 of this report. It was sent to members of the AP-FECM and was returned by 24 participants from the following economies: Australia, Bangladesh, Cambodia, Canada, China, Chinese Taipei, Indonesia, Japan, Malaysia, Mongolia, New Zealand, Philippines, Thailand, and Vietnam.

The first part of the survey was intended to identify the capacity for current forestry education by collecting data on: student enrolment, faculty numbers, faculty backgrounds and qualifications, graduation and employment rates, programme description and enrolment, tuition fees, language of students, and exchange programmes. Student enrolment was collected for 2005, 2010, and 2015 to identify any trends in enrolment at each participating university. Faculty composition including qualifications and research information was included for assessment of the quality of teaching staff. This information was compiled into an Expert's Database, available through the AP-FECM, to allow experts with similar research interests to connect for information sharing and knowledge exchange/collaboration.

Student enrolment was collected for each programme type to observe trends in enrolment levels. Programme names and descriptions were previously collected for the majority of the participating universities and this was used to create 11 groupings of programmes (e.g., Urban Forestry, Wood/Forest Products). Information explaining significant decreases or increases in enrolment was requested from each university to gain a better understanding of the factors influencing each programme in each economy.

The percentage of students entering forestry-related occupations, non-forestry occupations, or continuing their education was compiled for each participating university. Using this information, an analysis was completed to note any changes over time.

Tuition fees at each university were compared to the GDP per capita of each economy to scale the affordability of higher forestry education as a means to identify the affordability of higher education within an economy. Exchange

programme information was also collected to see what efforts had taken place to promote student exchange. The number of students and faculty on exchange was tabulated, as well as any financial aid that was given to these students and faculty.

Finally, information was collected from each university on the average level of English comprehension and use held by undergraduate and graduate students. Levels were based on the IELTS standards and included Beginner, Intermediate, Advanced, and Native Speaker levels.

Part 2 of the survey collected similar information to Part 1, but for the entire economy, to be filled out by the participants on behalf of other universities in that economy.

Part 3 gathered case study submissions from each participant to showcase the challenges faced and some of the solutions applied in the AP Region. Participants could select from one or more categories: (1) challenges in the region; (2) analysis of higher education in the region; (3) gaps between international and domestic forest education; (4) development of strategies for forest education regionally; (5) new initiatives to improve forest education; or (6) another topic of their choice. These case studies were used to gain a more detailed understanding of forestry education in the AP Region as experienced by each university.

Analyses were then conducted on trends in enrolment, frequencies, etc., to understand the current forest education capacity in the region.

1.3 OVERVIEW AND STATUS OF HIGHER FORESTRY EDUCATION IN THE REGION

The AP Region includes over 190 universities that offer more than 510 forestry-related programmes, ranging from forestry resources management to biodiversity and conservation (Tables 1.3.1 and 1.3.2). More than 124,000 students are studying forestry-related topics. Although sometimes close in proximity, AP economies are vastly different in their culture, traditions, economies, languages, and natural

environments. The region is rich in natural resources, and economic and social forestry potential.

The number of universities offering forestry-related programmes varies considerably from economy to economy within the AP Region. The variation in numbers could be a result of an entire university specializing in forestry rather than a specific Faculty/College or department within a university. Another important factor affecting the number of universities offering forestry programmes in the AP Region is government policy. For example, the large number of universities in China offering forestry programmes reflects not only the growing interest in sustainable development of an economy, but also the push for climate leadership through increased environmental and forestry-related programmes. Since China is the world's most populous economy, the high enrolment rate is proportionate to its population size. In comparison, Canada's high enrolment rate compared to its much smaller population size highlights its interest in forestry. Forest industries in Canada have long contributed a significant amount to its gross domestic product (GDP). Canada's high enrolment rate also reveals the growing interest in addressing the threat of climate change. Thailand's high enrolment rate compared to the small number of forestry-related programmes offered may be due to an overall increase in general university enrolment as a specific government policy to increase Thailand's education. The number of students reported by Australia is lower than other participating economies; this could be due to the reported dwindling of student interest in Australia. The University of Melbourne is addressing this challenge by creating new programmes that can attract students interested in both forestry and environmental studies. As well, New Zealand has a small student population in comparison to other participants, as the University of Canterbury is the only university in New Zealand that offers forestry-related degree programmes.

'Forestry' is the most prevalent forestry-related programme offered (126 programmes), followed by 'Forest Science' (116 programmes) and 'Biodiversity and Conservation' (78 programmes) (Table 1.3.2 and Appendix 2). How people view forestry practices, and forestry education in general, has changed over

Table 1.3.1 Number of universities, by economy, offering forestry-related degree programmes in the AP Region as found from the AP-FECM survey and information provided by the Association of University Forestry Schools of Canada (AUFSC 2016), and GFIS (2016). Specifics can be found in Appendices 1, 2, and 3.

Economy	Number of Universities	Number of Students
Australia	5	177
Bangladesh[a]	4	674
Cambodia	20	830
Canada	9	3,340
China[b]	28	102,383
Indonesia[c]	9	1,822
Japan	17	2,525
Malaysia[d]	3	867
Mongolia	5	360
New Zealand	1	123
The Philippines[e]	75	1,848
Thailand	3	3,031
Vietnam	5	1,729
Chinese Taipei	7	2,161
USA (West)[f]	8	2,261
Total	199	124,131

a Bangladesh reported 4 universities, including one that offers only a diploma programme, which was not taken into account in this report. The numbers of students reported are from the other 3 degree-granting schools.

b This data was provided by Beijing Forestry University (BFU), a key partner in China from available responses, actual number of universities and students may be higher than recorded.

c Indonesia reported 9 universities; however, the only data obtained was from IPB, totaling 1822 students.

d Malaysia reported 3 universities; however, the only data obtained was from UPM, totaling 867 students.

e The Philippines reported 75 universities; however, only 7 universities, totaling 1848 students, provided data for this study.

f There are more universities offering forestry-related programmes in the USA (West); however, only 8 responded to this survey

the years. In the future, it is expected that more universities will offer areas of concentration that focus on climate change, environmental science, and social studies.

Table 1.3.2 Forestry-related programmes reported by the AP-FECM Survey 2016 and found in the GFIS database. More detail can be found in Appendices 2 and 3.

Programme Type	Number of Programmes Available
Forestry	126
Forest Science	116
Biodiversity and Conservation	78
Wood/Forest Products	48
Landscape Management/Architecture	22
Ecotourism/Parks and Recreation	18
Economics in Forestry and Environmental Science	16
Agroforestry	14
Community Based Forest Resources Management	14
Environmental Studies	12
Water Resources Science and Management	7
Urban Forestry	7
Forests and Law	6
International Forestry	6
Social Studies	6
Forest Management Technology	5
Horticulture and Gardens	4
Plant/Animal Quarantine	3
Geographic Information Systems	2
Total	510

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CHAPTER 2

RESHAPING HIGHER FORESTRY EDUCATION IN THE AP REGION

Forestry education in the AP Region has been subject to some major changes over the last few decades. While enrolment in traditional forestry programmes remains high, universities now offer more diverse programmes linking forestry to environmental sciences and expanding knowledge to include natural resource management. Forestry education has changed to adapt to the environmental movement and pressures from both the practice and the public. Programmes are becoming more holistic in their approach, including managing human impacts within landscapes, rather than only managing the land. Student and faculty exchanges are becoming more popular as means of bridging the gap between international and domestic curriculum standards and increasing capacity. However, raising the quality of domestic education and increasing the number of teaching staff to address gaps and challenges have remained key foci for all of the participating universities.

2.1 TRANSFORMING FORESTRY

The economies that comprise the AP Region vary considerably in economic status, land area, population, forest ecosystems, and forest resource management approaches. These differences were reflected in the survey responses. Forestry education has shifted from a style of managing only forests to learning to manage human interactions with the forests with a focus on the sustainable use of resources. This shift can be seen in the development and enrolment trends of new and transformed programmes. Many participants reported merging natural resource conservation studies and environmental science with forestry education to accommodate external demands. The largest growth in programme development and student enrolment is occurring in the biodiversity and conservation-related programmes, reflecting a more holistic approach to forestry education.

Mergers of faculties and departments have occurred at many institutions as a response to the changing demand for forestry education. Out of the 87 universities for which information was available, 26 had forestry units (Table 2.1.1). At the other 61 universities, forestry-related programmes were offered by units in which

Table 2.1.1 Names of the units (Faculty/Department/School) offering forestry-related programmes at each of the participating universities.

Economy	Institution	Unit Name
Australia	University of Melbourne	School of Ecosystem and Forest Science
Bangladesh	Khulna University	Forestry and Wood Technology Discipline
	Sylhet University of Science and Technology	Department of Forestry and Environmental Sciences
	University of Chittagong	Institute of Forestry and Environmental Science
Cambodia	Royal University of Agriculture	Faculty of Forestry Science Graduate School
	Royal University of PP	Department of Environment
	School of Agriculture Prek Leap	Department of Forestry Science
	Thong Khmum Heng Samrin University	Faculty of Forestry and Natural Resources
Canada	Lakehead University	Faculty of Natural Resource Management
	University of Alberta	School of Forest Science & Management
	University of British Columbia	Faculty of Forestry
	Université Laval	Faculty of Forestry, Geography and Geomatics
	Université de Moncton	School of Forestry
	University of New Brunswick	Faculty of Forestry and Environmental Management
	University of Northern British Columbia	Faculty of Science
	University of Toronto	Faculty of Forestry
China	Anhui Agriculture University	College of Forestry and Landscape Architecture
	Beijing Forestry University	College of Forestry
	Beijing University of Agriculture	Plant Science and Technology College
	Central South University of Forestry and Technology	College of Forestry
	China Agricultural University	College of Resources and Environmental Sciences

Economy	Institution	Unit Name
China	Fujian Agriculture and Forestry University	College of Forestry
	Gansu Agricultural University	College of Forestry
	Hainan University	Institute of Tropical Agriculture and Forestry
	Hebei Agricultural School	College of Forestry
	Henan Agricultural University	College of Forestry
	Huazhong Agricultural University	College of Horticulture and Forestry Science
	Hunan Agricultural University	College of Horticulture and Landscape
	Inner Mongolia Agricultural University	College of Forestry
	Jiangxi Agricultural University	College of Forestry
	Jilin Agricultural University	College of Agriculture
	Nanjing Forestry University	College of Forest Resources and Environment
	Northeast Forestry University	School of Forestry
	North West Agriculture and Forestry University	College of Forestry
	Shandong Agricultural University	Forestry College
	Shanxi Agricultural University	College of Forestry
	Shenyang Agricultural University	College of Forestry
	Sichuan Agricultural University	College of Forestry
	South China Agricultural University	College of Forestry and Landscape Architecture
	Southwest Forestry University	Faculty of Forestry
	Xinjiang Agricultural University	College of Forestry and Horticulture
	Yunnan Agricultural University	College of Horticulture
	Zhejiang A and F University	Faculty of Forestry and Biotechnology
Chinese Taipei	Chinese Culture University	Department of Forestry and Nature Conservation
	National Chiayi University	Department of Forestry and Natural Resources Department of Wood-Based Materials and Design
	National Chung Hsing University	Department of Forestry

Economy	Institution	Unit Name
Chinese Taipei	National Ilan University	Department of Forestry and Natural Resources
	National Pingtung University of Science and Technology	Department of Forestry Department of Wood Science and Design
	National Taiwan University	Forestry Resources and Conservation
Japan	Kyoto University	Division of Forest and Biomaterials Science
Malaysia	Universiti Malaysia Kelantan	Faculty of Earth Science
	Universiti Putra Malaysia	Faculty of Forestry
Mongolia	International University of Ulaanbaatar	Department of Horticulture
	Mongolian University of Life Science	Department of Ecology
	Mongolian University of Life Science, Darkhan	Department of Ecology
	Mongolian University of Science and Technology	Department of Wood Processing Technology
	National University of Mongolia	Department of Environment and Forest Engineering
New Zealand	University of Canterbury	School of Forestry
Philippines	Aklan State University	College of Agriculture, Forestry and Environmental Science
	Aurora State College of Technology	Department of Forestry and Environmental Science
	Central Mindanao University	College of Forestry and Environmental Science
	Isabela State University	College of Forestry and Environmental Management
	Mindanao State University	College of Forestry and Environmental Studies
	University of the Philippines Los Banõs	College of Forestry and Natural Resources
Thailand	Kasetsart University	Faculty of Forestry
United States of America (West)	California Polytechnic State University San Luis Obispo	Natural Resources Management and Environmental Sciences Department
	Humboldt State University	Department of Forestry and Wildlife Resources

Economy	Institution	Unit Name
United States of America (West)	Oregon State University	College of Forestry
	University of Alaska Fairbanks	School of Natural Resources and Extension
	University of California Berkeley	College of Natural Resources
	University of Washington	School of Environmental and Forest Science
Vietnam	Vietnam National University of Forestry	Faculty of Forest Resources and Environment Management

the name 'forestry' did not appear or it was 'merged' with other disciplines, such as geography, natural resources management, and environmental sciences.

2.2 DEGREE PROGRAMME TRENDS

The popularity of programmes has changed over the past ten years as new types of programmes have been developed. Students' environmental awareness and concerns are reflected by increases in enrolment into a variety of forestry-related programmes (Figure 2.2.1).

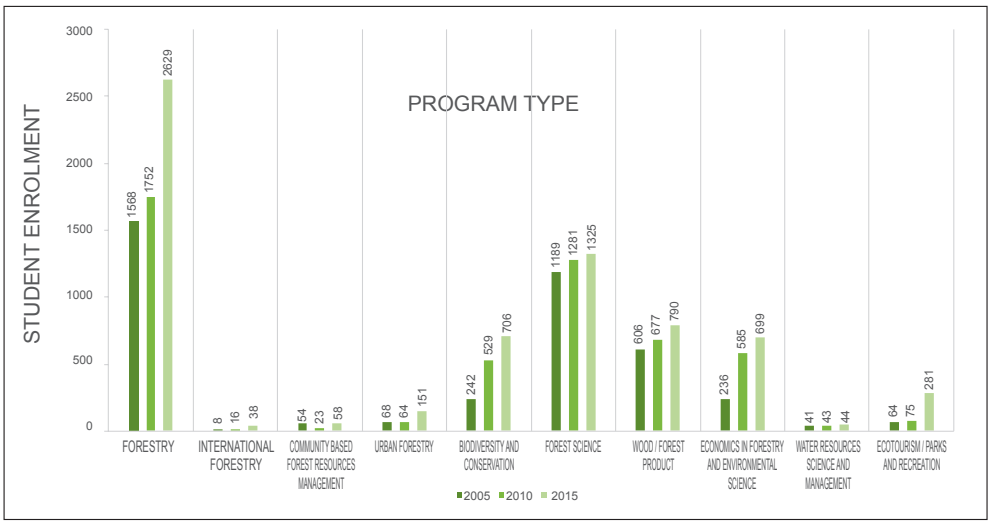

Figure 2.2.1 Programme enrolment trends from 2005-2015, as reported by AP-FECM survey participants, at the undergraduate and graduate level.

'Forestry' programmes provide a general foundational understanding of forestry; 'International Forestry' is similar, but focuses on a global scale and with greater emphasis on policy and politics. 'Community Based Forest Resources Management' encompasses socially-focused forestry programmes that specialize in human interaction and involvement. 'Urban Forestry' focuses on the study of forests in urban areas. The 'Biodiversity and Conservation' group contains all programmes that contain resource conservation fundamentals. The 'Forest Science' group has more focus on the science of forests, including plant science, biology, and species interactions. 'Wood and Forest Products', 'Economics in Forestry and Environmental Science', 'Water Resources Science and Management', and 'Ecotourism/Parks and Recreation' are specialized groups that provide a narrower area of study for students. The largest enrolment can be seen in the 'Forestry' programmes that consisted of about 2,600 students in 2015.

It is common for programme enrolment to vary by few percentage points year-to-year, based on demographics. Many of the programmes contained a small number of students in 2005, making any changes in enrolment significant. However, many participants reported more significant enrolment changes. Individual trends per programme type are displayed in Figures 2.2.2a-2.2.2k. These figures show the total for all students in the programmes: domestic, international, bachelor, master, and doctorate students. Enrolment information for each programme within the categories can be found in Appendix 3.

General forestry is the most common programme offered. This type of programme provides a broad background in biological, physical, social, political, and economic fundamentals of forestry, and focuses on forest resources management. Forestry programmes not only cover timber extraction, but also the management of forest resources and the preservation of them for future use. Such programmes allow students to gain a general understanding of forest resource management and the science behind it. Some universities offer degrees in other disciplines, such as in Forest Sciences, before allowing students to enter a Forestry programme at the Master's level. Data shown for BFU and UPM is indicative of this system,

where only graduate student enrolment is shown in the Forestry category. Using UPM as an example, the small enrolment in the graduate Forestry programme can be contrasted with the high enrolment in their Bachelors programme in Forest Sciences (Figure 2.2.2a and c).

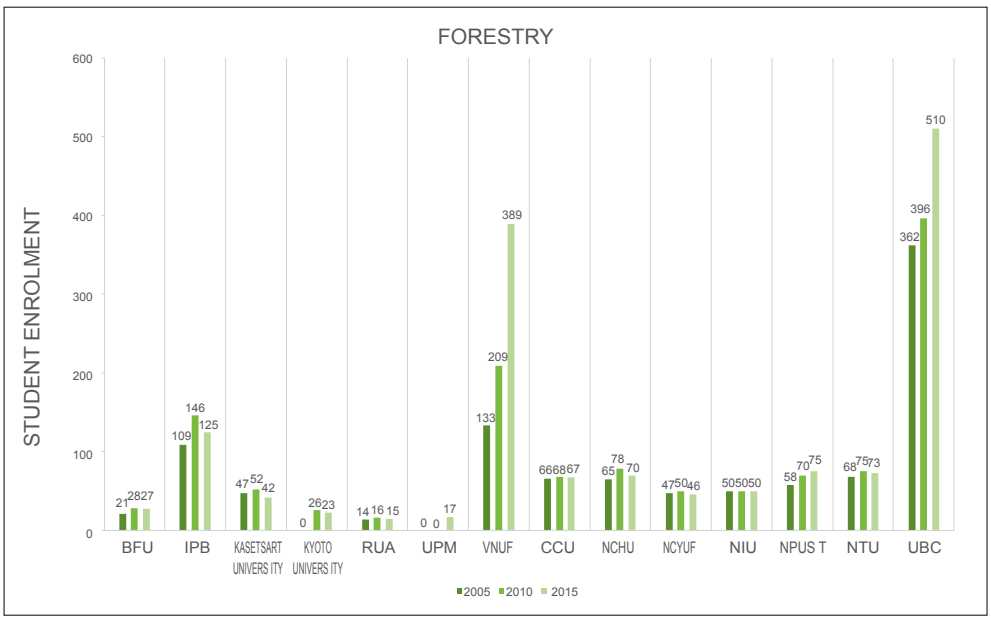

Figure 2.2.2a Forestry undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

Some participants reported limited areas of concentration and students were categorized as general forestry majors without a degree sub-specialization. UPLB is an example of this; this university offers only one undergraduate programme that focuses on general forestry, allowing for a broader understanding at a basic level. It encourages specialization in upper years and through graduate programmes. The increases in their enrolment were due to an expansion of allotted slots for students in their bachelor programme from 100 students per year to 200 students per year (Figure 2.2.2b). Similarly, IFESCU in Bangladesh also offers an option to do an honours programme in the general study of Forestry at an undergraduate level, as

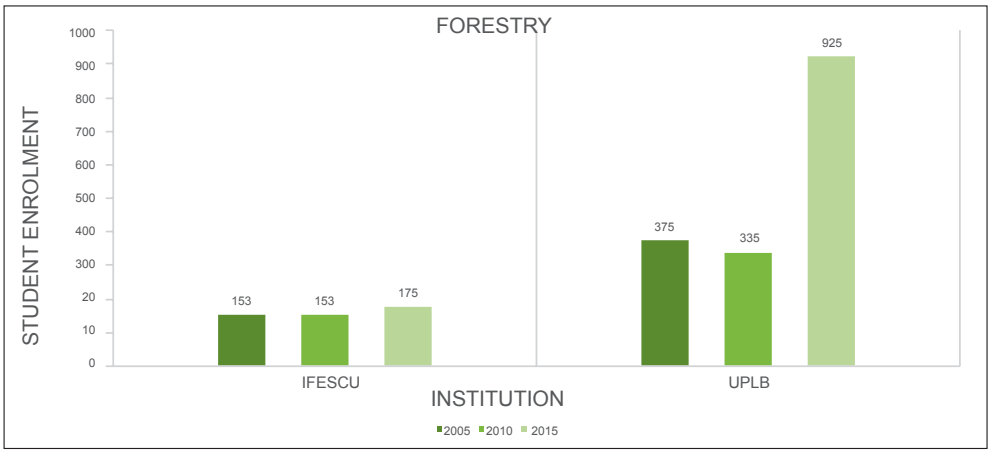

Figure 2.2.2b Forestry undergraduate and graduate enrolment from 2005 to 2015 in general forestry schools without degree sub-specialization, as reported by survey participants. More details can be found in Appendix 3.

well as a M.Sc. and Ph.D. programme in Forestry. Under the Forestry programme, students are able to explore courses in many fields, including ecotourism, wildlife management and remote sensing, forest science, and wood and forest products.

Forest Science programmes focus on the science of forestry, which can include biology, ecology, botany, etc. This programme type is similar to the general forestry concentration, but with a more intensive science background. Such programmes focus more on the interconnectedness of forest ecosystems and how the many parts work together. Forest science programmes vary greatly among universities, with some offering programmes that are more similar to general forestry, while others focus more on rigorous science. Enrolment in this programme type has been generally steady (Figure 2.2.2c). An exception to this is UPM, who reported decreased enrolment as a result of implementing a cap on the intake of forest science students to encourage focus on community-based forest management and parks and recreation.

Biodiversity and Conservation is one of the fastest growing forestry-related areas in the AP Region (Figure 2.2.2d). Students appear to be seeking education with a heightened focus on environmental protection and related issues, as well

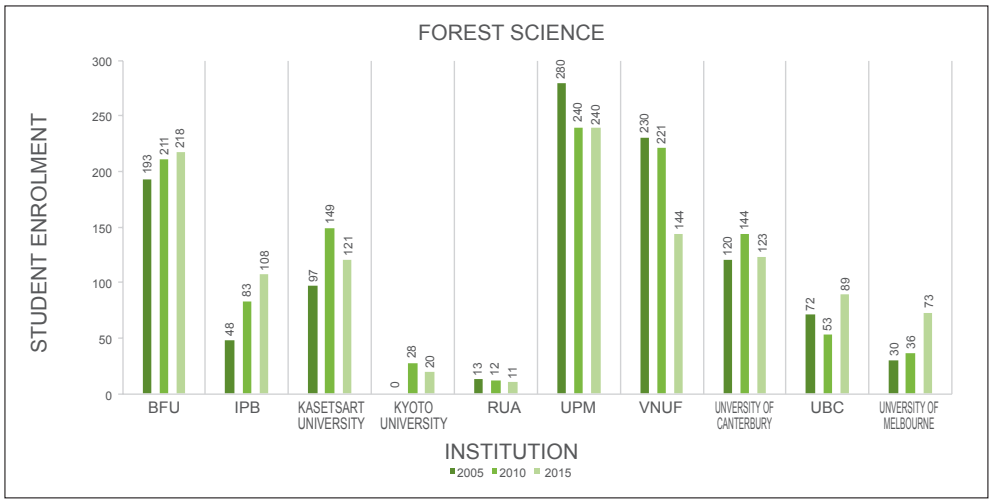

Figure 2.2.2c Forest Science undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

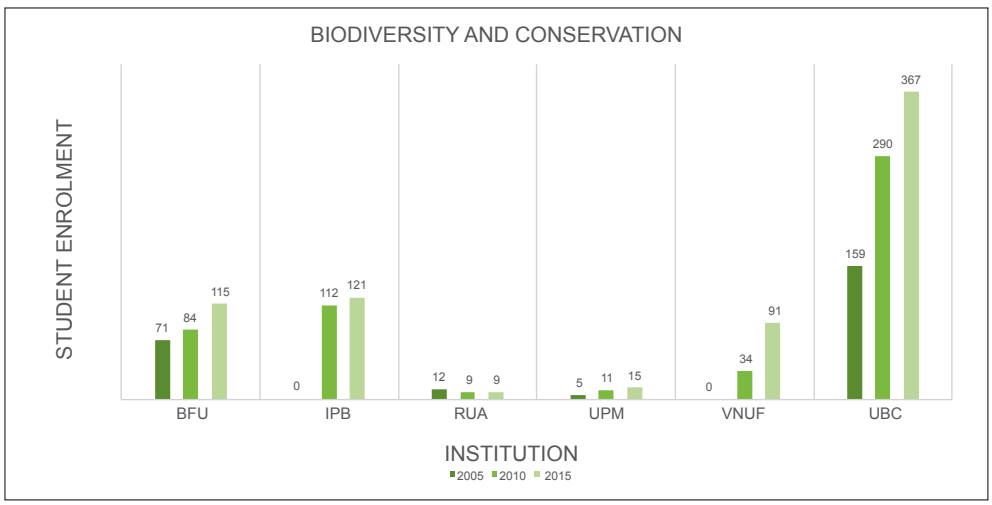

Figure 2.2.2d Biodiversity and Conservation undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

as resource assessment and management planning (Arevalo et al., 2012). As a consequence, many higher learning institutions have shifted to broader, greener, ecocentric, and socially-focused programmes (Smith & Koven, 2010). Biodiversity and Conservation programmes allow students to gain skills and knowledge to meet

the challenges presented by rapid urbanization, biodiversity loss, deforestation, and climate change. Students learn ways to maintain a healthy ecosystem while creating a balance between human demands and growing populations, and effective protection and rehabilitation for natural environments. Biodiversity and Conservation graduates are likely to enter the fields of resource conservation and ecological management and protection.

Urban Forestry is still a relatively new area of concentration, which could explain the small number of programmes and limited enrolment (Figure 2.2.2e). Urban Forestry focuses on planning and managing urban green spaces and natural areas. It has become important in many urban areas where ecology and human welfare are not incorporated into planning to protect and preserve green spaces. It differs from landscape architecture as it goes beyond the planning stage to incorporate sustainable development of green spaces. Rapid urbanization, coupled with the impacts of climate change, has heightened the demand for urban forestry professionals. UBC launched their new Bachelor of Urban Forestry (BUF) programme in September 2015 and has observed

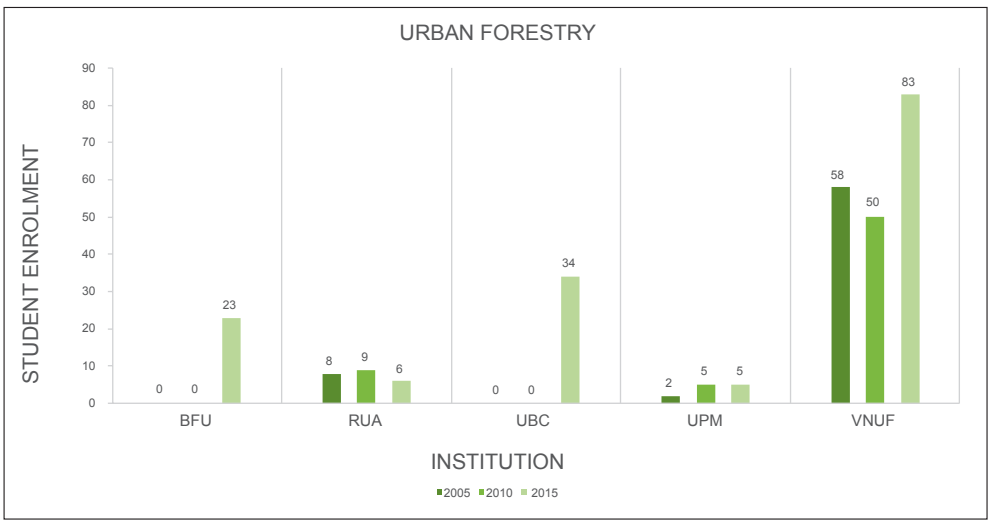

Figure 2.2.2e Urban Forestry undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

a growing demand for this programme; it has grown from 34 students at its inception to over 100 students in 2016.

Community-Based Forest Resources Management has been a growing focus for many universities in the AP Region (Figure 2.2.2f). This area has become more popular as social interests have become more prevalent. Many economies have promoted the need for consultation and some forms of accommodation for local groups in the decision-making process. The lower enrolment rates and fewer programmes are due to the specialized nature of these programmes. Some participants (e.g., IFESCU, VNUF) reported that their general forestry programmes already incorporated community involvement in their curricula. Often the communities in question are Indigenous communities. For example, UBC has incorporated Aboriginal interests into a number of courses they offer and the University of Canterbury was planning to develop a learning strand that focuses on the Maori connection with forestry. As mentioned above, UPM has implemented a maximum enrolment cap on their Forest Science programme to encourage more students to enter the fields of community-based forest management and parks and recreation.

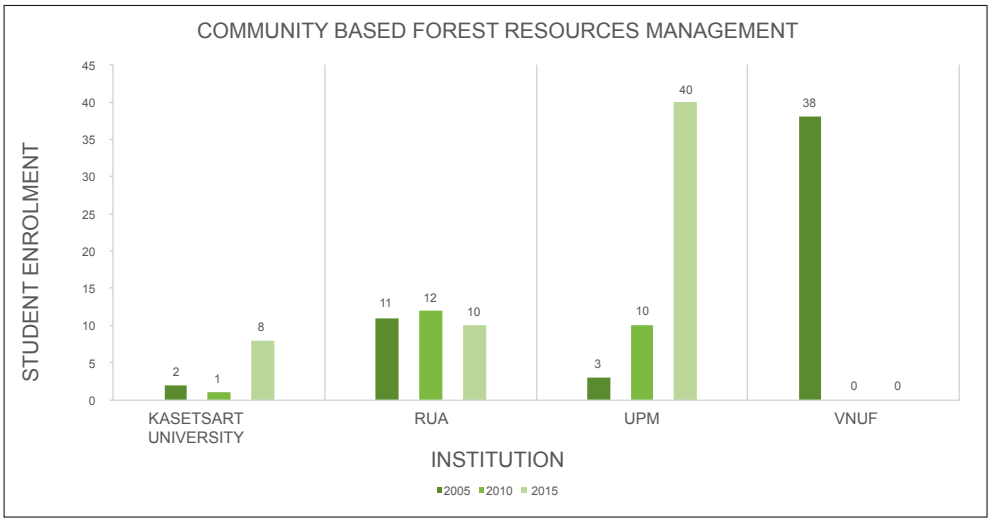

Figure 2.2.2f Community Based Forest Resources Management undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

International Forestry has experienced growth over the last 10 years in the universities that offer these programmes (Figure 2.2.2g). Solutions to the challenges facing forests and forestry in the AP Region are being developed on an international stage with resource and knowledge sharing. International Forestry gives students an opportunity to gain skills that employers are seeking on negotiations, policy design, and implementation on an international stage. These programmes are more commonly offered at a Master's level (e.g., UBC, Kasetsart University, UPM, and RUA). As climate change is integrated into curricula, so is international collaboration, as domestic challenges are often global in nature. Globalization was identified as both a concern, and an area of development impacting forests in participating economies by the survey.

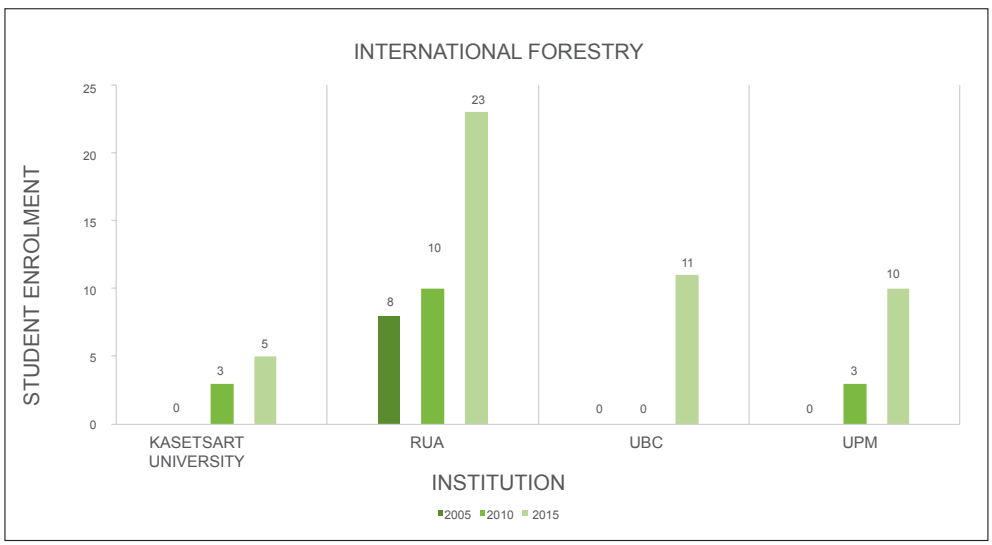

Figure 2.2.2g International Forestry undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

Enrolment was reported to fluctuate for many participants in Wood and Forest Products (Figure 2.2.2h). The most noticeable drop was at VNUF; they suspect that their low enrolment is due to the low average salaries and poor work environment for graduates. However, many of the other participants reported a steady enrolment of students in Wood and Forest Products. This type of programme

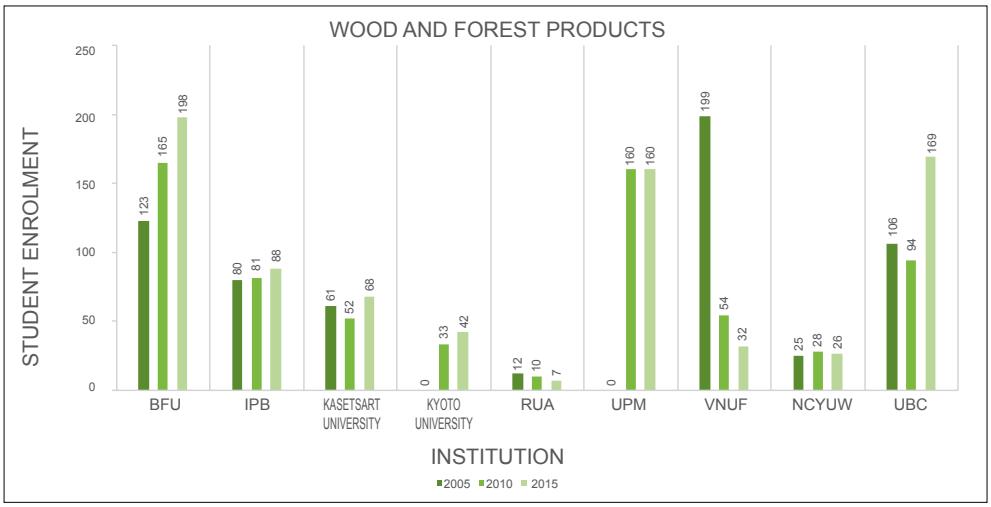

Figure 2.2.2h Wood and Forest Products undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

allows for students to gain a comprehensive understanding of wood science and the economics of manufacturing and distribution of wood products. It is likely that some programmes in this area were not reported. For example programmes in pulp and paper manufacturing may be associated with Chemical Engineering rather than Forestry, and programmes in wood design and construction may be associated with Civil Engineering or Architecture.

Enrolment in specific programmes such as Forestry Economics is not as high as it is in more general programmes like Forestry that incorporate economics as part of their programme (Figure 2.2.2i). Forest Economics programmes go into much more depth than general programmes and normally introduce students to the economics of production, distribution, and consumption of forest products and resources. Such programmes can also include skill development regarding conservation and forest investment, non-timber economics, payments for ecosystem services, and forest certification. Forest Economics and Management, offered at BFU, was listed as one of the favoured disciplines in China in 2007.

Water Resources Science and Management is a specialized programme that is only

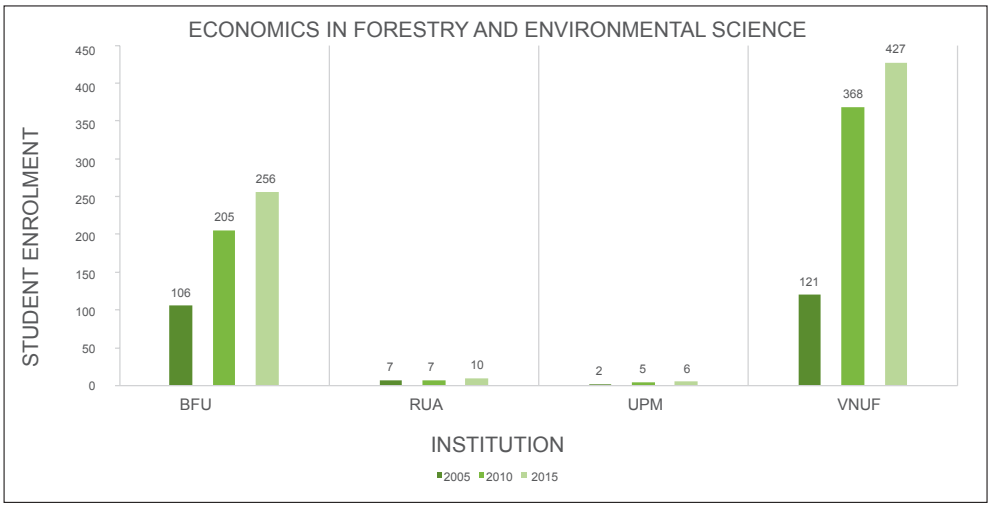

Figure 2.2.2i Economics in Forestry and Environmental Science undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

offered at three of the participating universities, although many of the participants offer courses in this aspect of forestry as part of their other programmes (Figure 2.2.2j). Water Resources Science and Management focuses on the hydrological services provided by forests and the management required to maintain them.

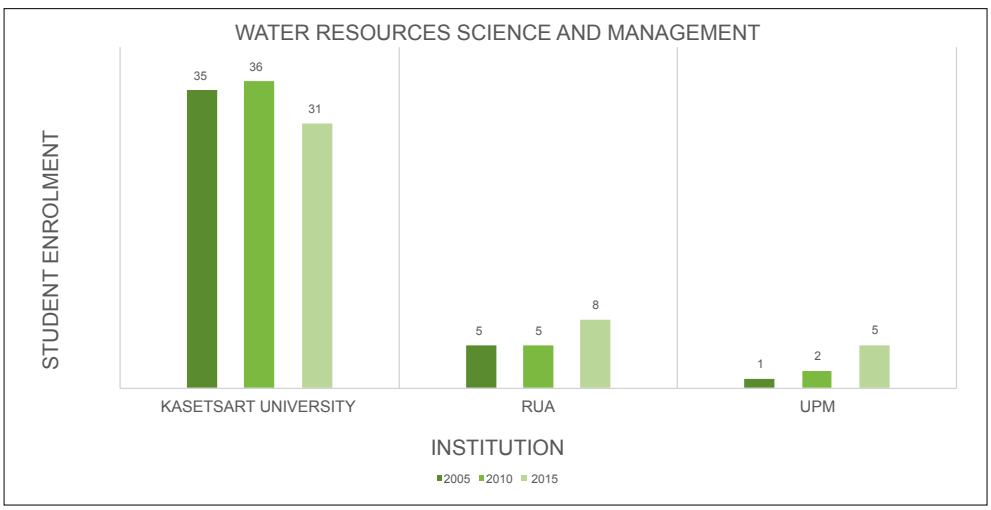

Figure 2.2.2j Water Resources Science and Management undergraduate and graduate enrolment from 2005 to 2016, as reported by survey participants. More details can be found in Appendix 3.

Certain forest practices can have an irreversible effect on water resources, and foresters must be aware of these impacts and work to mitigate them, for example by selecting proper harvesting techniques. Such programmes are often offered at a graduate level with low enrolments (e.g., as at UPM).

Ecotourism/Parks and Recreation is an emerging field of study that has experienced a doubling in enrolment from 124 students in the region to 361 (Figure 2.2.2k). This increase can be explained by the expanding demands of the sector and also by the public perception of traditional forestry. An example of this can be seen in Chinese Taipei, where the use of forests has shifted from logging/extraction to recreation and ecosystem services due to a logging ban (Weng et al., 2013). Higher forestry education has adapted to these changes by shifting focus to alternative uses of forests, such as ecotourism.

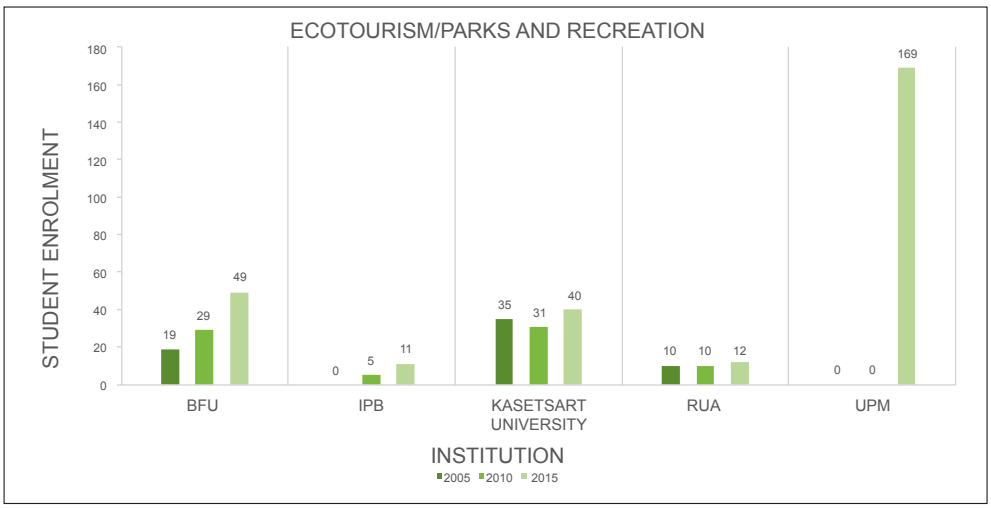

Figure 2.2.2k Ecotourism/Parks and Recreation undergraduate and graduate enrolment from 2005 to 2015, as reported by survey participants. More details can be found in Appendix 3.

Although general Forestry programmes have remained the most widely offered programme type with the highest overall enrolment over the 10 year period covered by the survey, higher growth in enrolment has occurred in sustainability-focused programmes. This has been driven by a growing public interest in sustainability

issues and concern that traditional logging practices may not be sustainable. Universities are now hosting more programmes that focus on forest science and ecosystem services, along with how to properly manage human use of the resources and conserve the land for biodiversity purposes.

The programmes discussed above are by no means an exhaustive list of forestry-related programmes offered (see Appendix 2 and 3). As well, there are other fields, such as agroforestry, landscape architecture, climate change and botany, that are also related to forestry. However, enrolment data on these related programmes are scarce and some such programmes are relatively new.

2.3 EMERGING PROGRAMMES

Forest education in the AP Region is expanding outwards and upwards. Higher birth rates, school participation, and enrolment rates explain the need for the region to expand outwards with the development of more higher education opportunities. Expanding upwards by creating more graduate education supports regional demands for research and development to boost local economies and environmental protection (Chapman & Chien, 2014).

Those programmes that were reported to have no initial enrolment in 2005, but were present in 2015, were designated as 'emerging' programmes (Table 2.3.1.) These emerging programmes are more ecologically and environmentally focused, as well as being more targeted to graduate education (24 of the 33 programmes reported are at the Master and Doctorate levels), than programmes that were in place in 2005. Some of the emerging programmes bridge with other disciplines to develop solutions for socio-environmental issues. As an example, UBC's Master of Geomatics for Environmental Management programme offers knowledge in geospatial skills as well as in landscape ecology to tackle complex environmental management issues. Another emerging area is Urban Forestry. BFU launched an Urban Forestry programme in 2010 and UBC did so in 2015. The University of Melbourne intends to so in 2017.

Table 2.3.1 Emerging programmes (zero enrolment in 2005) as reported by survey participants.

Institution	Emerging Programme Name	Programme Level	Enrolment Growth from 2005 to 2015
BFU	Forest Science	Master	62
	Urban Forestry	Bachelor	23
IFESCU	Forestry	Master	25
	Environmental Sciences	Bachelor	20
IPB	Forest Conservation and Ecotourism	Bachelor	109
	Tropical Biodiversity and Conservation	Master	10
		Doctorate	2
	Tropical Silviculture	Master	15
		Doctorate	3
	Ecotourism and Environmental Services	Master	7
		Doctorate	4
Kasetsart University	Tropical Forestry	Master	5
	Parks Recreation and Tourism	Doctorate	3
UBC	Geomatics for Environmental Management	Master	NEW
	Sustainable Forest Management	Master	36
	Urban Forestry	Bachelor	34
University of Melbourne	Forest Ecosystem Science	Master	50
	Urban Forestry	Master	NEW
UPLB	Forestry	Bachelor	550
UPM	Forest Management and Ecosystem Services	Master	14
		Doctorate	3
	Parks and Recreation Management	Bachelor	160
	Sustainable Recreation and Tourism	Master	7
		Doctorate	2
	Forest Management and Conservation	Doctorate	8
	Wildlife Ecology and Management	Master	2
		Doctorate	2
	International Forestry	Master	10
	Wood Science and Technology	Bachelor	160

Institution	Emerging Programme Name	Programme Level	Enrolment Growth from 2005 to 2015
VNUF	Natural Resources Management	Bachelor	46
	Forest Resources Management	Master	14
		Doctorate	14
	Forestry	Bachelor	9
	Wood Technology	Doctorate	2

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CHAPTER 3

CURRENT HIGHER FORESTRY EDUCATION TRENDS

Observing the 10-year change in higher forestry education enrolment separately for the Asia and the Pacific sub-regions of the AP Region allows for a greater understanding of what factors are influencing forest education and what actions should be taken for future capacity building. This chapter examines student enrolment at each participating university from 2005 to 2015. Explanations for observed trends are provided to identify the factors that are likely impacting enrolments.

An analysis of teaching quality was done by evaluating the availability of teaching staff and the qualifications of the instructors. Finding highly knowledgeable individuals who are available to teach can be challenging for some universities in the AP Region.

Employment rates were examined to understand the current health of the economies in the region, as well as to identify any gaps that may exist in curriculum when preparing students for the workforce.

The impact of accessibility of education on enrolment rates was examined through an analysis of tuition fees in comparison to GDP per capita in each economy, the availability of exchange programmes, and other obstacles such as language and credit recognition that may hinder successful exchange programmes.

3.1 ENROLMENT TRENDS

Economies located in the Pacific part of the AP Region have had historic economic advantages over their counterparts in the Asia region. This fact confounds the analysis of enrolment trends between AP economies. Consequently, the analysis of enrolment trends was separated into the 'Asia Sub-Region' (Bangladesh, Cambodia, China, Chinese Taipei, Indonesia, Japan, Malaysia, Mongolia, Philippines, Thailand, and Vietnam) and the 'Pacific Sub-Region' (Australia, Canada, New Zealand, and Western USA).

An overall increase in enrolment can be observed at the undergraduate and graduate level in both sub-regions, with a total increase of 1012 undergraduate

students in the Asian universities (Figure 3.1.1) and 794 students reported by Pacific universities (Figures 3.1.2). A more notable increase in graduate student enrolment was seen in the Asian universities (1315 students) compared to the Pacific universities (157 students). Many of the Asian economies are promoting graduate level education to boost economic growth and to develop more skilled professionals for the workforce.

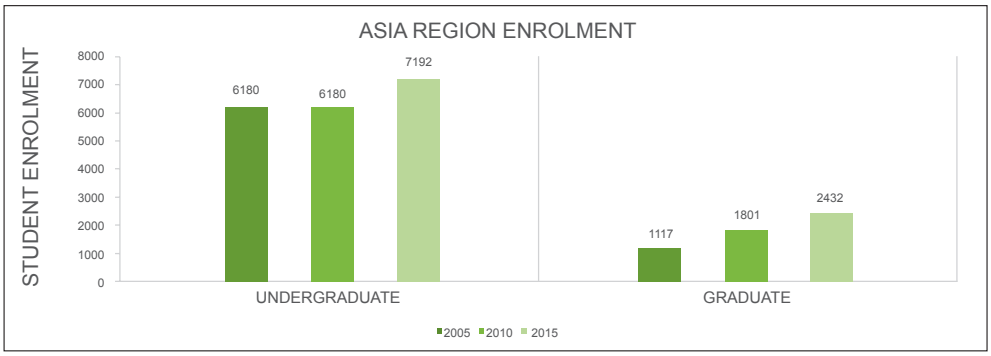

Figure 3.1.1 Undergraduate and graduate enrolment trends in the Asia Sub-region from 2005-2015[1].

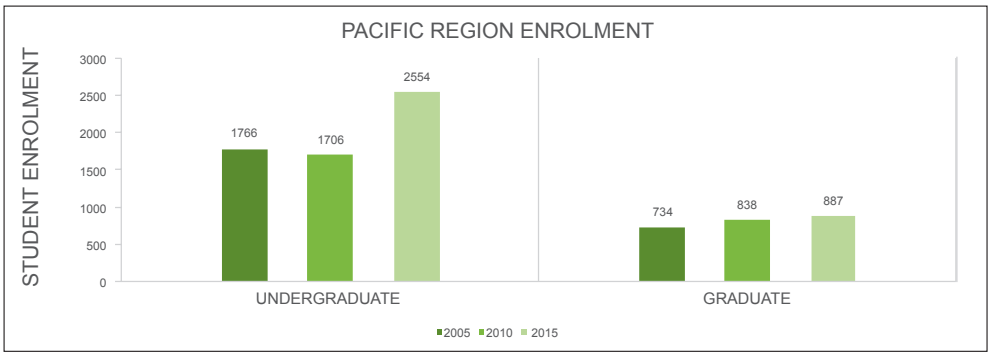

Figure 3.1.2 Undergraduate and Graduate enrolment trends in the Pacific Sub-region from 2005-2015[2].

1 Asia Region enrolment data was collected from IFESCU, IPB, Kasetsart University, Kyoto University, NFEC, RUA, UPLB, UPM, VNUF, CCU, NCHU, NCYUF, NCYUW, NIU, NPUST, NTU, and Beijing Forestry University.

2 Pacific region enrolment data was collected from University of Canterbury, University of Melbourne, University of Alberta, UBC, Lakehead University, Université Laval, Université de Moncton, University of New Brunswick, UNCB, and University of Toronto.

3.1.1 INTERPRETATION OF THE RESULTS FOR THE ASIAN SUB-REGION

Details for the Asian universities are given in Figures 3.1.3 and 3.1.4 and Tables 3.1.1 and 3.1.2.

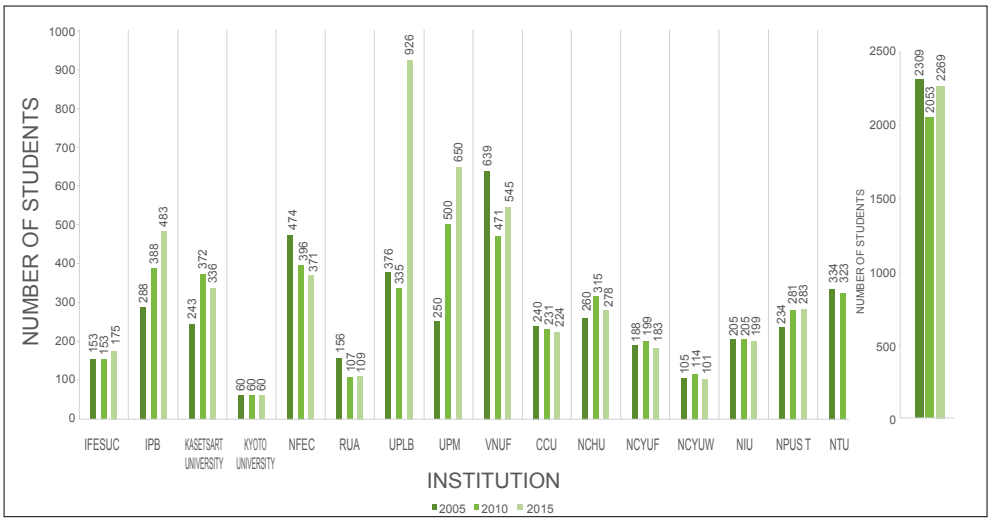

Figure 3.1.3 Undergraduate enrolment in the Asia Sub-region from 2005-2015.

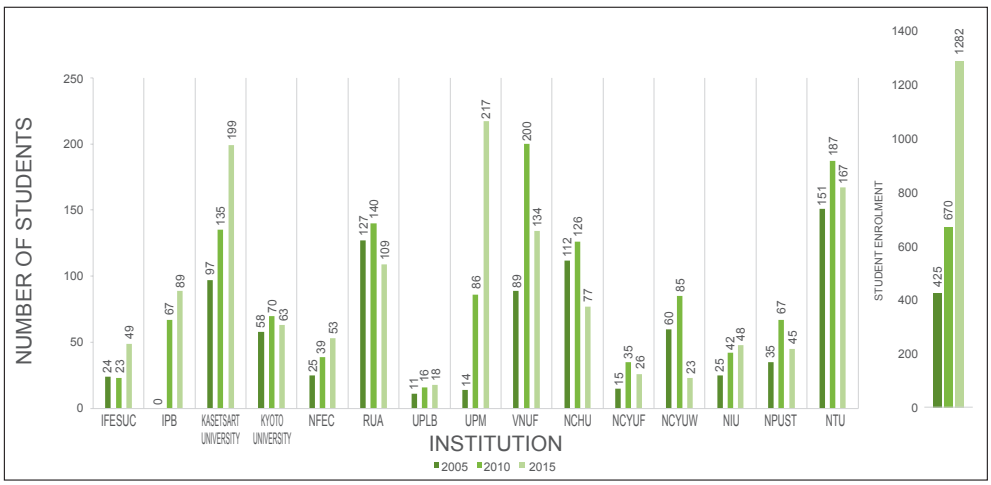

Figure 3.1.4 Graduate enrolment in the Asia region from 2005-2015 as reported from the AP-FECM survey participants.

Table 3.1.1 Universities in the Asia Sub-region experiencing growth in undergraduate students from 2005 to 2015.

Institution	Increase of Undergraduate Students
IFESCU	22
IPB	195
Kasetsart University	93
NCHU	18
NPUST	49
UPLB	550
UPM	400

Table 3.1.2 Universities in the Asia Sub-Region experiencing growth in graduate students from 2005 to 2015.

Institution	Increase in Graduate Students
BFU	881
IFESCU	25
IPB	89
Kasetsart University	110
NCYUF	8
NFEC	28
NIU	23
NPUST	10
UPLB	13
UPM	208
VNUF	41

IFESCU in Bangladesh experienced an increase in enrolment of 40 students in their programmes in association with modifying their curriculum to integrate more social forestry management. Kasetsart University reported increases in applications to their forestry-related programmes due to promoting available and accessible education to females. In the past, forestry and forest education was a male-dominated field of research and work. However, with the development of equal

opportunity learning and the movement towards equality in the workforce, more females are entering the forestry programmes. As the public becomes more aware of environmental issues, the field becomes more attractive for potential students and more are apt to pursue higher levels of specialized education. Although the forestry sector was reported as shrinking in Thailand and fewer forestry-related jobs are available, there is still an emphasis on students enrolling in higher forestry education.

BFU reported significantly higher undergraduate enrolment rates over the period due to demographics and government policies. BFU is a well-established and high-ranking university situated in the world's most populous nation, China. Therefore, their enrolment is higher than many of the other universities in the region. The Chinese government has implemented policies that promote higher levels of education to stimulate economic and social development, and have provided subsidies and funding to aid university development. This has impacted BFU in a positive way, allowing them to accommodate more students, and develop more specialized undergraduate and graduate programmes.

In the Philippines, a notable increase in enrolment was reported by UPLB, which jumped from 376 to 926 undergraduate students between 2010 and 2015. However, there was a decrease of 214 students in 2016 as a result of recent changes in government policy, with high-school education being extended from grade 10 to grade 12.

Although there is a general increase in student enrolment to forestry programmes in the Asian Sub-region universities, some participants reported a decrease. For example, RUA experienced an overall decrease (47 students); it was felt that this decrease was due to forestry not being as attractive to students as other programmes, such as environmental science, engineering, and economics. Increasing populations with limited quality forestry staff, and inadequate practical equipment and field activity support, have made training new professionals difficult. VNUF also experienced a decrease in enrolment (94 students). This was thought to be a result of many new provincial universities being established, and

students having many more choices than before.

Other universities reported government policy to be reducing student enrolment. For example, government policy on timber products and logging bans has negatively impacted the enrolment of students into forestry-related programmes in Chinese Taipei universities. Forestry graduates are having more difficulty finding relevant work than graduates of conservation or other ecologically-based programmes.

Graduate enrolment is notably increasing in a larger portion of universities (Figure 3.1.4; Table 3.1.4). Of the 17 universities offering graduate programmes, 11 of them reported increases in graduate student enrolment. This result was expected given the intensive efforts at increasing graduate enrolment reported by each university, as well as efforts by many of the regional governments to increase funding and promote higher education.

Expansion of graduate programmes has been a part of many universities' strategic plans to fill the growing knowledge gap. BFU reported that the Chinese government established policy that encourages the development of, and enrolment of students into, graduate programmes. Having more master and doctoral graduates is thought to boost economic growth and stability through research and development. An increase in research capacity in an economy attracts foreign investment and promotes development and innovation, all of which boost economic prosperity (Chapman and Chien, 2014). China has embraced the benefits of highly educated graduates and has developed policy to support more students to enter graduate education.

China is not the only economy to promote higher education; it is an approach taken by many of the home economies for the Asian Sub-Region universities. There are also pressures from the market, which is seeking employees with more knowledge than that obtained for an undergraduate degree. This is particularly true for some of the higher-paying positions. Students are responding by seeking graduate education to enhance their competitiveness in the workforce.

3.1.2 INTERPRETATION OF THE RESULTS FOR THE PACIFIC SUB-REGION

Enrolment trends in the Pacific Sub-Region do not vary much from those reported by the Asia Sub-Region participants; however, the scale is significantly different (Figures 3.1.5 and 3.1.6). Capacity and resources to educate and accommodate students are generally much higher than in the Asia Sub-Region.

There was an overall increase of over 700 students in undergraduate programmes during the reporting period (Figure 3.1.5). Most Canadian universities observed an overall increase in enrolment, other than the Université de Moncton and UNBC. UBC showed the most dramatic increase, doubling enrolment during the reporting period. Part of this increase is due to modification of course and programme content to promote sustainability. Active international recruitment of students has also helped in UBC's growth.

The University of Canterbury in New Zealand is working to increase enrolment by increasing the opportunity for students to exercise problem-solving, critical thinking, teamwork, and communication skills. They are also developing a learning strand that focuses on the Maori connection with forestry, particularly their role as land and forest-owners. New Zealand differs from the other Pacific Sub-Region

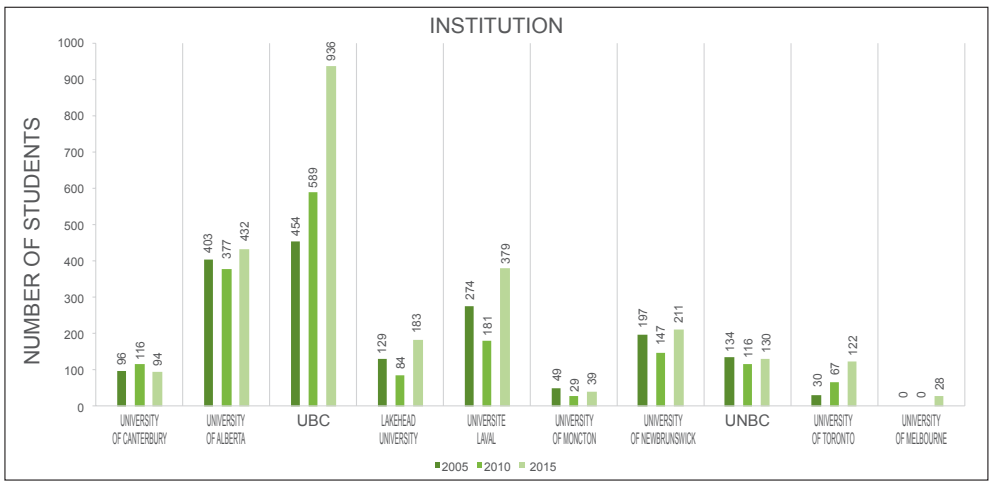

Figure 3.1.5 Undergraduate enrolment in the Pacific Sub-Region from 2005-2015, obtained from the AP-FECM survey and AUFSC.

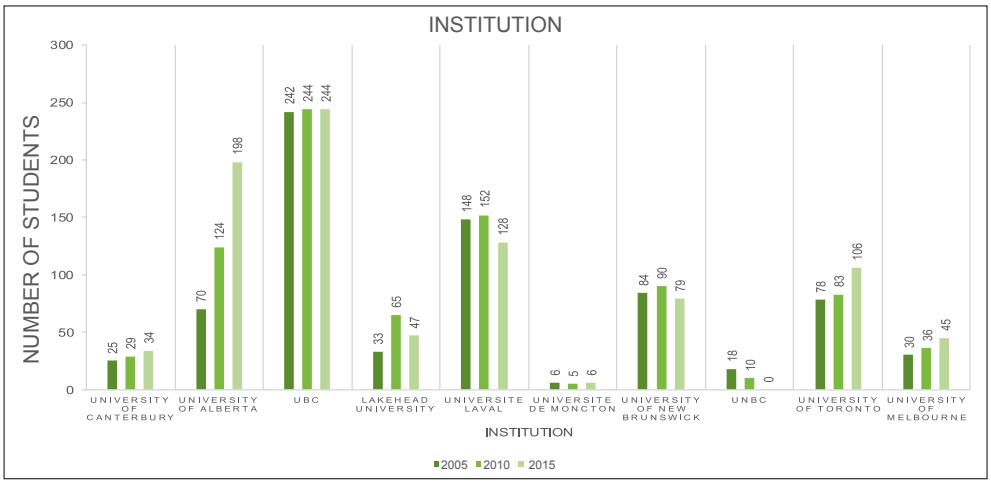

Figure 3.1.6 Graduate enrolment in the Pacific Sub-region from 2005-2015, obtained from the AP-FECM survey and AUFSC.

economies as government policy only permits the harvesting of planted trees and not natural forests on government land (Hammond, 1997).

The lower enrolment rates observed in Australia can be explained by students changing to more general environmental science and natural resource management programmes. This led to the closure of the largest Australian Forestry programme in 2005. However, the University of Melbourne formed the 'School of Ecosystem and Forest Science' within the Faculty of Science in 2015. This school created a specialized approach to learning for students dedicated to the study of ecosystem processes, sustainable land management, and environmental social science in forests and other ecosystems.

Graduate enrolment in the Pacific Sub-Region also increased, although not as much as undergraduate enrolment, with an increase of 153 students from 2005 to 2015 (Figure 3.1.6). Efforts to promote graduate education in this sub-region are encouraged by some governments and such programmes are popular among students. More recently, graduate degrees have become the standard for better paying jobs and for gaining a competitive edge in the workforce. Many of the Pacific Sub-Region participants expressed a goal of developing more graduate

programmes and encouraging more international exchange at that level, and some universities are already doing so. For example, the University of Melbourne has recently developed a new Urban Forestry programme, and is revising their other Master programmes to update and enhance the curricula.

3.2 TEACHING QUALITY

Determining the quality of higher forest education in the region is important to develop future programmes and projects. The quantity of forest education varies from economy to economy, with some universities having many forestry programmes and specializations. Capacity to educate students is crucial, both in the availability of forestry professors and also with respect to their previous training and present expertise. The quality of higher forestry education in the region has been reported as a topic of concern and development for many of the survey participants. For example, Kasetsart University in Thailand, mentioned concerns over the competitive nature of academia having negative impacts on the quality of education. Many professors and staff are being pressured to publish papers at a faster rate with higher levels of quality, and there are claims that this is compromising the quality and availability of teaching.

The quality of higher forest education is not solely represented by university rankings, student enrolment, or professor abundance; fundamentally, it is evidenced by the quality of teaching and learning that is taking place at each of the universities. To understand the availability of small classroom style learning, student−instructor ratios were compiled, based on overall student enrolment and available forestry teaching staff. From the ratios, further analysis to determine instructor composition and qualifications was undertaken.

3.2.1 STUDENT - INSTRUCTOR RATIOS

The student−instructor ratio acts as an indicator of the availability of teaching staff

and small class style learning; it does not indicate the true 'quality' of the forest education. However, studies have shown that optimal student learning occurs where student to teacher ratios are smaller. A meta-analysis completed on student learning found that smaller classes led to more successful learning, especially for low-ability and disadvantaged students (Cooper, 1987). The AP-FECM Forestry Education Survey results highlight a diversity in student to instructor ratios in the partner universities. The largest ratio was above 30:1 and the smallest classroom size sits at a ratio of lower than 10:1. The student to teacher ratio for the majority of these universities falls within the average of 15-20 students per instructor. It is interesting to note that universities in both the Asia Sub-region and Pacific Sub-region do not show significant differences in student to instructor ratios. Rather, the small student enrolment seems to be mildly correlated to a smaller student to instructor ratio. However, universities that can accommodate large student enrolments with an appropriate number of teaching staff also showcase a low student to instructor ratio. While not a definitive indicator on quality of education, an appropriate ratio allows students to seek one-on-one help with the professor if necessary. A teaching assistant can help with larger classes and assist students with learning in small group styles. Ideally, the smaller the ratio, the higher the quality of learning, and the more engaged the students.

3.2.2 INSTRUCTOR QUALIFICATIONS

The composition of the instructional staff of the survey participants is given in Figure 3.2.1. It is important to note that universities differ in their educational requirements for instructors.

In Canada, where professorial ranking is based on educational background and experience, professors, and associate professors are required to have extensive experience in their field (10+ years) with a distinguished record of research and publications and they must generally hold a doctorate degree. Some assistant professors and lecturers may be doctoral candidates. All survey participants from

Figure 3.2.1 Faculty composition of participating universities in 2016

economically advantaged economies indicated that education standards are assessed by governmental boards, making them competitive on a global stage. Participating universities in the Asia Sub-Region, aside from RUA and VNUF, reported that most of their professors and lecturers hold a doctoral degree, and that efforts are underway to increase these numbers. The five universities in Mongolia reported that 80% of their faculty members hold a master degree as their highest credential.

The teaching staff composition impacts the quality of education in the region. For example, VNUF and RUA reported concerns about finding knowledgeable and experienced faculty. At VNUF in 2012, nearly 30% of graduates could not find proper jobs and needed to be re-educated. Lecturers comprise 96% of their teaching staff (Figure 3.2.2) and there are no individuals who hold doctoral credentials (Figure 3.2.4). RUA also contains a majority of lecturers (Figure 3.2.3), although more staff hold doctoral credentials (Figure 3.2.5). Both institutions have made it a priority to work to standardize, compare, collaborate, and exchange faculty and curricula to enhance the quality of education at their university.

This statistical break-down highlights the quality of education based on the instructor education level in the region. It clearly illustrates the difference in standards between

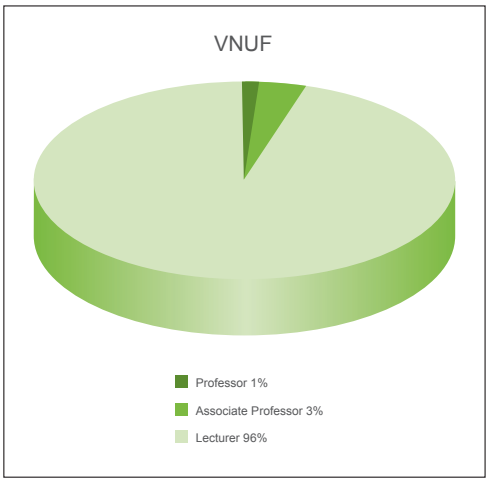

Figure 3.2.2 VNUF faculty composition.

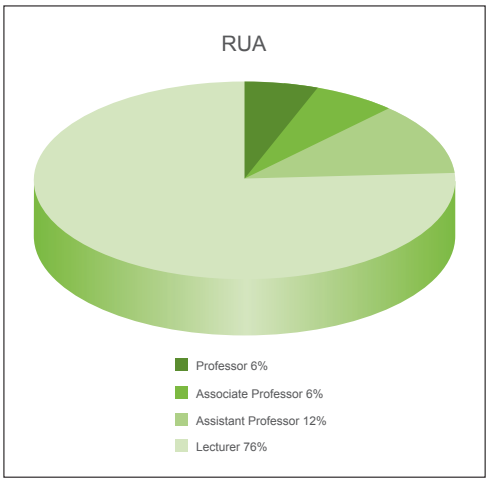

Figure 3.2.3 RUA faculty composition.

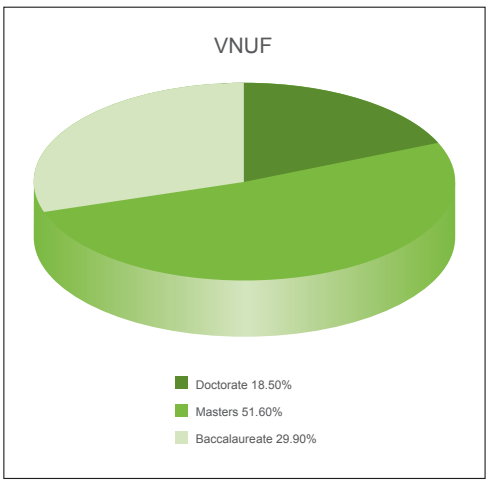

Figure 3.2.4 Instructor level at VNUF.

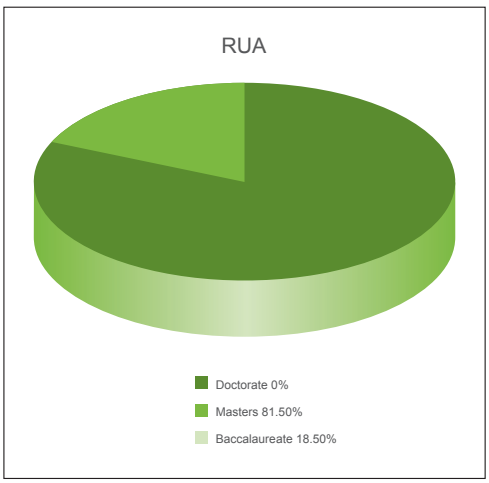

Figure 3.2.5 Instructor level at RUA.

economically-advantaged and disadvantaged economies. However, all participants reported capacity building to increase the quality of their education.

3.3 EMPLOYMENT RATES

Gaining perspective on employment trends can provide a more comprehensive understanding of challenges facing higher forestry education. The economic

situation in an economy influences the job market, which in turn affects graduates ready to enter the workforce. Employment rates are closely linked to university enrolment. Understanding where students are going post-graduation is integral to enhancing educational capacity in the region and formulating solutions to meet the needs of the students and the economy.

Employment in the AP Region has been steady overall, with most graduating students from forestry programmes entering a forestry-related line of work (Table 3.3.1). Information is not available for all of the participating universities. Employment rates are not a direct reflection of the effectiveness and usefulness of the reported programmes, but are more heavily influenced by the economic and social situation of an area.

At BFU, the percentage of students continuing their education after a baccalaureate degree increased from 4% in 2005 to 42% in 2015. Non-forestry employment dropped over this period as more graduates are entering forestry-related fields. Similar trends were observed at Kyoto University where there was a small increase in what was already a large percentage of students seeking further education. UPM also experienced an increase in the percentage of students seeking further education. However, CCU experienced a smaller percentage of students choosing to continue their education and more entering the workforce in both forestry and non-forestry jobs. The other universities listed all showed relatively steady percentages of students entering into the different categories.

Employment information can be a challenging to acquire as many students lose contact with universities after graduation. IFESCU has reported that it is more common for students to graduate from their bachelor degree and move on to higher education. Promotion of post-baccalaureate education has been seen in many parts of the AP Region. Specialization through graduate study is important for increasing research and development capabilities in the region.

Table 3.3.1 Percentage of graduates continuing their education, taking forestry-related work, or taking non-forestry related work.

	2005			2010			2015		
Institution	Continuing Education	Forestry Related	Non-Forestry Related	Continuing Education	Forestry Related	Non-Forestry Related	Continuing Education	Forestry Related	Non-Forestry Related
BFU	4	N/A	N/A	31	44	24	42	50	8
CCU	59	22	19	50	26	24	25	30	45
IFESCU	100	0	0	100	0	0	100	0	0
Kasetsart University	3	92	5	3	92	5	3	92	5
Kyoto University	N/A	N/A	N/A	84	4	12	88	3	9
RUA	34.2	53.1	12.6	33	52	15	27	62	11
University of Canterbury	7	80	13	0	91	9	0	88	12
UPLB	0	100	0	7	93	0	2	98	0
UPM	10	60	30	30	40	30	30	40	30
VNUF	N/A	N/A	N/A	N/A	N/A	N/A	10	80	10

3.4 ACCESSIBILITY OF EDUCATION

There can be obstacles to accessing high quality education for many students in the AP Region. Students can face challenges in choosing the best university to attend due to distance, tuition and living expenses, as well as language and cultural barriers.

3.4.1 TUITION FEES AND FINANCIAL AID

The quality of education, the economic status of an economy, and government involvement in education all influence tuition fees, making comparison at an international level difficult. Sri Lanka reported at the 4th AP-FECM meeting that

undergraduate level education was free at 15 universities across the economy. Many other participants reported government subsidies to aid students. However, most students are charged for some portion of their education, which is why many participants reported efforts to enhance funding and scholarship programmes for students in need.

Tuition fees plus living costs, textbooks, and other university fees for students are displayed in Figure 3.4.1, scaled to the economy's gross domestic product per capita, provided by the World Bank/APEC. Tuition as a percentage of the GDP per capita can represent affordability. The cost of education can be prohibitive to many who come from rural and remote areas. Vietnam reports that many of their students are from low income families and rural communities. Scholarship programmes help to ensure broader access for qualified students.

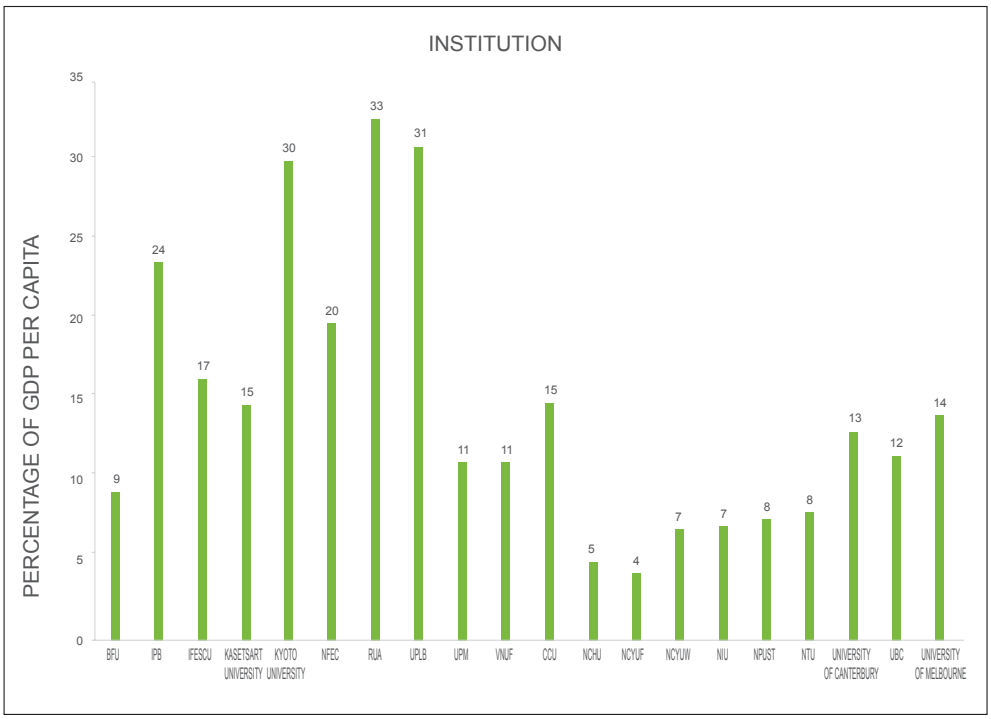

Figure 3.4.1 Percentage of GDP per capita of undergraduate domestic tuition fee by institution as provided by survey participants, APEC, and The World Bank, 2016. See Appendix 5 for more details.

Tuition is more expensive, but average income is higher, for the Pacific Sub-region participants; consequently, those universities fall in the middle of the pack in Figure 3.4.1. Students in Japan, the Philippines, and Cambodia experience a greater financial burden, with higher tuition costs compared to average income. On average, Japanese students pay more for tuition that their regional counterparts; this is also true in Korea where students do not receive as much government funding as students in North America and Oceania (OECD, 2016).

As part of the Ministry of Education, Youth and Sport's Education Sector Plan in 2014, the Cambodian government increased scholarships and opportunities for eligible students, and improved the relevancy of higher education. Scholarship rates have been on the rise in Cambodia, doubling at public universities from 2009 to 2013; however, efforts are still being made to create affordable and accessible education for all students (Education Strategic Plan, 2014).

In 2017, the President of the Philippines instituted conditional free tuition for all state institutions and colleges, although priority must still be given to financially disadvantaged, but academically able, students. The Higher Education Support Fund aims to increase the funding to State Universities and Colleges based on the estimated income from the previous fiscal year (Commission on Higher Education, 2017).

3.4.2 INTERNATIONAL EXCHANGE

Faculty and student exchange programmes allow for sharing of knowledge and resources and enable participants to gain valuable experiences abroad. While on exchange, students learn about different ecosystem types, management practices, and forest policies. Faculty exchange is an opportunity for knowledge sharing and development training; faculty from various foreign institutions can go abroad to conduct research and learn different teaching styles, and bring that knowledge back to their home university. However, exchange programmes can present some challenges to both students and faculty. Foremost among these is higher costs.

This issue has become an important focus for many universities and many of the participants are working to create affordable student and faculty exchange programmes.

Eighteen of the 24 universities covered in the survey (BFU, CCU, IFESCU, IPB, Kasetsart University, Kyoto University, NCYUW, NFEC, NIU, NPUST, NTU, RUA, UBC, University of Canterbury, University of Melbourne, UPLB, UPM, and VNUF) had student exchange programmes in place. Of those universities, 44% had external funding available, either through the university or through government support. As well, 15 active faculty exchange programmes were in place in 2015 (BFU, CCU, IFESCU, Kasetsart University, Kyoto University, NFEC, NPUST, NTU, PIB, RUA, UBC, University of Canterbury, University of Melbourne, UPLB, UPM, and VNUF); 56% of the institutions offered funding to cover either the full expenses, just the travel, or just the food/accommodation.

BFU and Kyoto University had the largest student exchange programme of all the participants, sending 75 students and 61 students, respectively, abroad in 2015. The largest faculty exchange was reported by VNUF who sent 54 faculty members abroad and BFU who sent 43 faculty members abroad in 2015.

Effective exchange programmes can work to mobilize students and share curricula and expertise. However, most existing programmes are still lacking proper funding for students to afford university abroad, especially students from lower income communities and economies seeking education in more developed regions of the world.

Financial barriers are not the only factor hindering cross-border exchange; language and curricula can also be an impediment. The average English levels for undergraduate students and graduate students in the AP Region are given in Figures 3.4.2a and 3.4.2b. The English levels of faculty members from various institutions were not recorded in the survey; however, lack of language skills can also deter faculty members from going abroad, and if they do go, limit their experience.

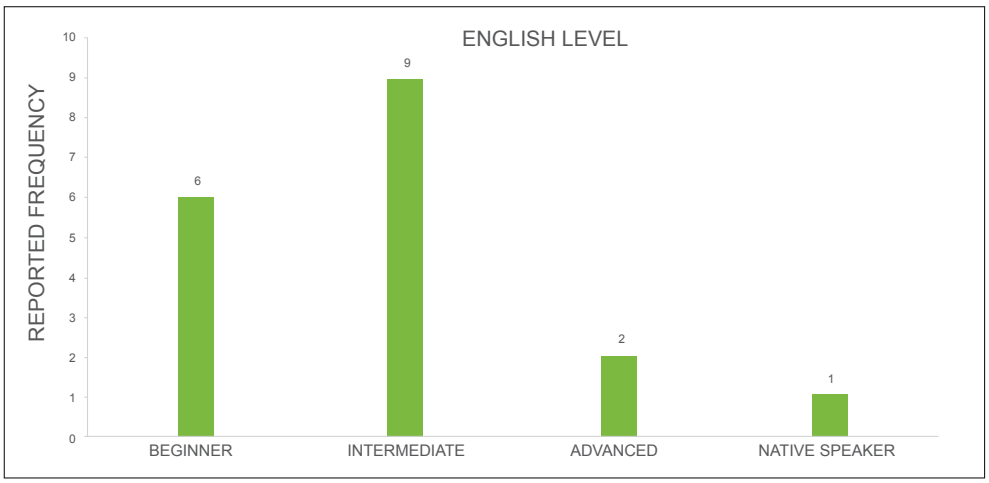

Figure 3.4.2a Undergraduate student English level as reported from survey participants in the AP Region in 2016.[3]

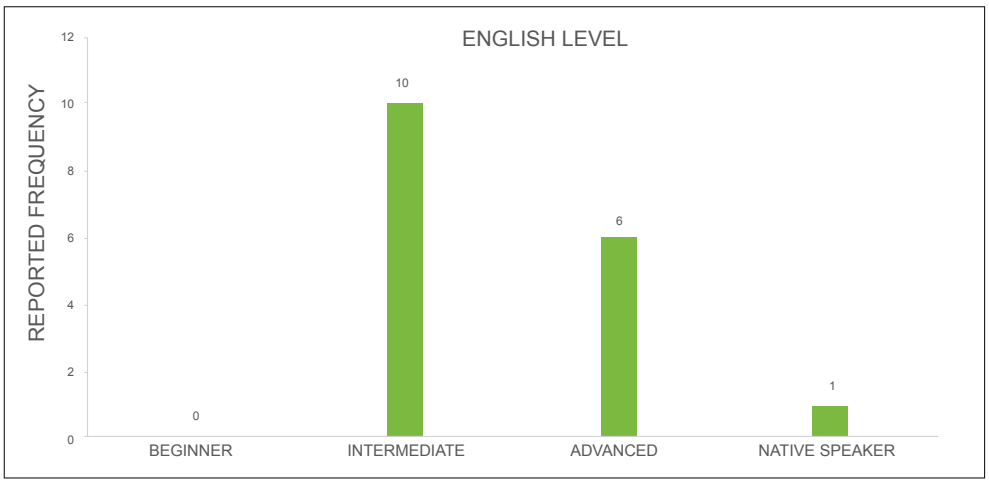

Figure 3.4.2b Graduate student English level as reported from survey participants in the AP Region in 2016.

3 The English level is based on the IELTS standards that provide a scale of understanding from basic/beginner English to experienced/advanced English. Basic and beginner understanding of the language requires candidates to understand and use simple expressions when responding to daily encounters and scenarios. Intermediate level English requires students to understand key points and to express themselves regarding familiar subjects and areas of interest. Students with Advanced level English can use complex phrases, read, write, and speak almost fluently.

Many of the university participants are working to overcome language barriers for both students and faculty members by increasing the material taught in English. Aside from the Pacific Sub-Region universities, which with two Canadian exceptions are English speaking, 12 of the participating institutions provide some courses taught in English (Table 3.4.1). UPLB and IFESCU are exceptions, since they both offer English as the main language of instruction for their courses.

Table 3.4.1 Number of classes offered in English at Asian Sub-Region universities, sorted by degree level.

Institution	Undergraduate Level	Graduate Level	Doctorate Level
BFU	2	2	2
IFESCU	1	2	1
Kasetsart University	0	1	0
Kyoto University	0	1	1
NCYUF	1	0	0
NFEC (5 Universities)	1	0	0
NIU	0	1	0
NPUST	0	1	0
NTU	5	2	0
RUA	0	6	0
UPLB	126	67	67
UPM	1	0	0
VNUF	5	1	0

Curricula differences are the final obstacle to creating accessible education for students through international exchange. It can be a challenge for many students to transfer credits from their exchange experience to their home university. Credits gained through exchange can be more easily recognized within their economy; however, beyond that, comparisons of curricula are required to confirm which credits are transferable. As there is no international standard for higher forestry

education, courses taken elsewhere are not always recognized by other universities. Participating universities in the AP Region are working to standardize courses to address this challenge.

For short-term exchanges, students can go abroad through global exchange programmes that allow for a few credits to be transferred easily and recognized at a student's home university. For longer term exchanges, programmes such as UBC's 2+2/3+2 transfer approach compare curricula from the participating universities before exchange to determine if the material is similar enough to provide credit or exemptions from certain courses at UBC.

3.5 SUMMARY

Forestry education is adapting to meet the challenges faced in the AP Region. Despite those challenges, enrolment in forestry-related programmes increased in the period from 2005 to 2015. However, some universities experienced enrolment decreases in general forestry programmes because of more students entering the conservation and environmental science fields. To adapt to this shifting demand, some universities are changing organizational structure from traditional forestry faculties or departments to natural resources conservation, biology, environmental science, and other such units, sometimes simply through name changes and other times through mergers.

The participating universities are working hard to promote higher levels of education, both in forestry and in other related fields of study, to increase research and development capacity. Both the number of graduate programmes and graduate student enrolment have been increasing. Graduate programmes are becoming more popular as a means for students to gain expertise and a competitive edge when entering the workforce.

Employment rates for forestry graduates are highly complex as they are influenced by economic, social, and political factors, as well as the success and effectiveness of programmes. Traditional forestry jobs can be difficult to find in certain

economies. That is one of the factors prompting forestry programmes to become more holistic in programme content.

The apparent quality of forestry education in the region varies from university to university. Some universities reported difficulties in finding suitable experts to teach their programmes. Others are working to promote more knowledge sharing platforms and exchange opportunities for students to help bridge gaps in expertise. Students at many of the participating universities have the opportunity to learn English in their home economies and receive financial aid to conduct some of their studies abroad. However, faculty member and student exchanges can be challenging due to cost, language and cultural barriers, and issues with transfer credits. Many of the universities reported collaboration efforts to compare curricula and improve exchange resources.

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CHAPTER 4

FORESTRY EDUCATION EFFORTS IN THE AP REGION

This chapter presents some of the lessons learned from universities' educational practices, problems encountered, and solutions employed. The AP Region is extremely diverse in its culture, economy, society, and environment. These differences make each part of the region unique in terms of challenges and solutions with respect to capacity building in higher forestry education. Individual analyses from participants are presented first, followed by gaps in forestry education for different regions and the importance of capacity building and, lastly, initiatives and plans for increasing regional and domestic education. The documents provided by various participants are given in Appendix 7.

4.1 ANALYSIS OF HIGHER FOREST EDUCATION

Participants were given the opportunity to submit an analysis of the current state of their programme(s). Through this self-analysis, participants could address the unique aspects of their situation. These analyses explored educational structure, curricula, and the main features of higher forestry education in their areas. Some participants took this opportunity to explore the history of their university and how it came to be the educational institution it is today.

Higher forestry education in China began at the start of the 20th century. There are two main aims of forest education in China: (1) to promote sustainable forest development and (2) to cultivate skilled professionals with practical skills to help produce a sustainable environment. The submission by BFU covered their efforts to increase the percentage of graduate students in forestry. In addition, their analysis focused on the need to develop a comprehensive curriculum for students to ensure that graduates are well equipped with new skills that can meet the needs of the changing world.

BFU believes that despite the growth in forestry education in China, the current education structure lacks applicability towards the forest industry. Current curricula consist of professional required courses, professional elective courses, public required courses, public elective courses and professional practice courses. While

varied and in depth, the current curricula do not allow undergraduate students to select topics that truly interest them. With graduate students, the strong focus on practical and technical courses leads to a lack of independent learning and cross-disciplinary knowledge, which is critical in developing a more comprehensive understanding of forestry topics at a higher level. A gap between theory and practice was observed and while efforts to alter teaching approaches are in place, many are still considered traditional and impersonal towards individual student learning.

Forestry Education in Taiwan was an analysis submitted on behalf of six forestry-related universities in Chinese Taipei. This analysis focused on the current state of forestry education and possible future developments. It was noted that each of the six universities possesses their own experimental forest. These forests enable many research projects, including those of graduate students, and provide hands-on learning opportunities for students. Developments are being made to ensure that students are being educated at a higher skill level, with more technical and practical skills to adapt to the changing needs of the forestry industry.

IPB stated that there are few opportunities for new graduates to get jobs in Indonesia because of forest land conversion and reductions in forest concessions, in line with increasing population growth and regional development. As a consequence, there has been a reduction in enrolment into their forestry programme. Less than 25% of newly enrolled students chose forestry as their first choice. However, that percentage has been improving (in 2017 it increased to about 40%). IPB believes that this change is due to the recent increasing demand for foresters in palm oil plantation management. Plans to adapt their curriculum to be more applicable for individuals seeking forestry employment have been put in place. They are also working to promote international collaboration and exchange throughout the region.

Although there are programmes in forest science in Japan, there was concern regarding the downsizing of universities and their continuing ability to provide higher forestry education. Budget cuts to universities have led to a drastic reduction

in faculty members. As of 2015, policy in Japan groups universities into three categories, which may have substantial impacts on forestry education. Japan has been working to combat a declining domestic population by increasing the number of international students in their programmes. Many short-term exchange programmes have been put in place to aid in the recruitment of international students. There are plans to increase international student scholarships and internationalize Japan's universities overall to promote higher forestry education and increase enrolment.

The National Forestry Education Consortium (NFEC) in Mongolia released the Forestry Education Survey to their members and received 5 responses. Mongolia has a few universities offering studies in forestry and forest science, although these are often combined with other fields of natural sciences. Challenges in Mongolia are similar to those found across the region including outdated curricula, issues with teaching quality, lack of networking between universities, and lack of connection between education and industry. Priority needs include development of curricula, credit exchange, faculty exchange and support from other universities, facility improvements, and more funding.

4.2 GAPS IN FORESTRY EDUCATION IN THE AP REGION

The survey, enabling comparisons of forestry programmes and curricula on an international platform, is valuable for identifying gaps and challenges. Development of new forestry programmes is essential for capacity building; however, a notable gap exists between theory and practice, where forestry education in classrooms is not sufficient to equip forest practitioners on the ground. This issue is further exacerbated by the lack of forestry-related employment for graduates, as is shown through the small number of graduates actually working in the industry. This issue was expressed in the majority of the case studies. There was also a consensus on the need to revise current forest curricula to introduce more cross-disciplinary

studies and to reduce the focus on extractive uses of forests.

Forestry curricula differ among universities in the AP Region, most notably between the Asia and Pacific Sub-Regions. Some programmes do not meet internationally held standards for higher level education and cannot be compared with programmes from more developed nations. Two case studies were submitted on this topic, the first by the University of Canterbury, New Zealand, and the second by the Royal University of Agriculture (RUA), Cambodia.

The University of Canterbury offers the only professional forestry degree programmes in New Zealand. They reported on the process of benchmarking their forestry programme against those of several other universities. Benchmarking, which is performed every few years at the University of Canterbury, works on an international level to ensure that programmes are up-to-date and of high quality. Their programme generally contained less ecology, fewer foundation courses such as mathematics and English, and more emphasis on forest biometry, forest management and economics, and wood products than their comparators.

Benchmarking also occurs in an unstructured way between universities in the region through assessments of faculty members' performance during promotion reviews. These are generally done confidentially, so no information is available on the extent of the practice. It is normal practice in the Pacific sub-region, and increasingly being used by universities such as UPM in the Asia sub-region.

The Royal University of Agriculture, Cambodia, reported on a series of reforms in recent years to adapt their programmes to a more sustainable forest management focus. With changes in forest lands in Cambodia and promotion of SFM, enhancement of higher forestry education through cooperation and educational programmes has become important. This will narrow the gap between forestry education in Cambodia and that provided in more developed economies, and improve networking between educational institutions. Their limited capacity led them to express concerns about their ability to match domestic forestry education to international standards.

4.3 IMPORTANCE OF CAPACITY BUILDING

Increasing forestry capacity in the AP Region is important for a strong economy and a sustainable environment. Capacity building can occur in several ways; however, the major means is through developing relevant curricular materials and enhancing the abilities of the teaching staff. All of the submitted case studies touched on the importance of capacity building.

Capacity is of particular concern in the less developed economies. For example, RUA (Cambodia) was concerned with declining enrolment and thought that it was due to lack of capacity in the forestry programme. Submissions from Bangladesh and Thailand also discussed the importance of capacity building for new programmes and expanding research and development efforts.

The Institute of Forestry and Environmental Science at the University of Chittagong (IFESCU), Bangladesh, submitted a report entitled I*ncorporating New Knowledge Base in the Curriculum of Professional Forestry Education in Bangladesh*. In this study, IFESCU expressed the need for forestry education to incorporate new areas such as climate change, biodiversity conservation, forest-people conflict management, landscape level restoration, forest resource monitoring, invasive species management, carbon management and trading, and panel wood and wood processing business. All of these topics of study are similar to the ones discussed in Chapter 2 of this report.

Kasetsart University submitted a case study entitled *Importance of Capacity Building in Forest Genetic Resources Conservation in Asia and Pacific*. In this submission, they discussed the importance of forestry education incorporating genetic resource conservation and management. They highlighted the need for capacity building in research and development, as well as overall forestry education. More graduate students are needed in the field of forest genetics to ensure the future of at-risk species and to promote genetic diversity throughout the region.

4.4 NEW INITIATIVES TO IMPROVE FORESTRY EDUCATION

Developing new programmes and projects is essential to overcome the challenges and bridge the observed gaps in higher forestry education in the AP Region. All participating universities listed their strategic plans for increasing capacity, which mostly involved the development of new programmes, increasing resources, and revising curricula, all while networking internationally.

Higher forestry education has undergone fundamental changes in curriculum development, student enrolment, and teaching quality. Programmes are shifting to address the global changes that are affecting regional forests and forest educational systems. Many participants shared their initiatives including increasing scholarship funding, promoting international exchange, reviewing curricula, and developing new programmes.

The University of British Columbia provided a case study *UBC: Development of the 2+2/3+2 Programs for Degree-Seeking Transfer Students*. In this submission, UBC shared their experience in developing an undergraduate transfer programme between UBC's Faculty of Forestry and four Chinese forestry universities. This transfer programme has achieved its aim to bring in transfer students from the region. The transfer programme does more than provide a platform for student exchange, it also provides a student support network to enhance the Chinese students' experience in Canada. Introductory programmes have been developed to allow students to acquaint themselves with forest education in the context of British Columbia. This period also allows for students to acclimatize to life on UBC campus and gain cross-cultural experience by immersing themselves in the UBC community. Roughly 30% of the participating students have continued their studies in graduate programmes across North America, and another 50% have chosen to work in Canada after completion of their degree at UBC. The 2+2/3+2 programme also provides mid-career training and capacity building workshops for Chinese faculty members, and sharing of educational resources and concepts. Visiting scholars that come to UBC through this programme are able to enhance their skills in their field of study, while participating in an interactive environment to develop

teaching strategies and skills. This case study showcases the mutual gains possible in successful transfer programmes.

Transfer programmes such as the one offered at UBC, and the partner exchanges occurring at other participant universities, are key initiatives for improving forestry education. These programmes work to narrow the gap among participating universities, share resources and knowledge, while allowing participating students and faculty to obtain a more comprehensive understanding of SFM.

A new joint master programme in Tropical Forest Biodiversity and Conservation has been developed by IPB, UPM, and UPLB. Two workshops have been held, 2016 in Bogor, and 2017 in Manila, to share experiences and collectively develop the curriculum for the joint educational programme. This programme has been created to produce individuals who can effectively address biodiversity and conservation issues in Southeast Asia.

4.5 SUMMARY

Noteworthy efforts have been made by the participating universities in the AP Region. Each university has developed strategic plans and taken actions to increase capacity at their university and sometimes have contributed across the region. Some universities are working closely together, such as, for example, Kasetsart and Kyoto, and UBC and BFU. These partnerships provide a platform for communication between universities and aid in promoting the development of higher forestry education.

The AP Region faces considerable challenges. Addressing these challenges as a more unified group of universities through sharing knowledge and collaborating on strategy and capacity building can improve higher forestry education. Efforts are being made to understand the current status of forestry education as demonstrated through the analyses provided by participants. Universities are working in partnership to narrow the gap between domestic and international forest education through exchange, courses and curricula comparisons.

CHAPTER 5

SUMMARY AND RECOMMENDATIONS

Enrolment numbers are generally increasing in traditional forestry programmes across the AP Region, as well as increasing in a broad array of forestry-related programmes addressing some aspect of SFM. This growing interest in SFM reflects the current awareness within the scientific community and the public as to the important role that forests can play in mitigating climate change and supplying a wide range of ecosystem services. Forestry education is adapting to this awareness by offering joint programmes and moving away from a traditional focus on extractive aspects of forests to a focus on managing the forest in balance with human and ecological needs. Although the transition to a more holistic approach is commendable, it is important that the quality of education is maintained. Partnerships between universities to standardize education quality are needed.

Some recommendations to improve the quality of forestry education will be discussed in the remainder of this chapter.

5.1 CHANGING HIGHER FORESTRY EDUCATION

The AP Region has over 190 universities offering forestry-related education and close to 510 specialized programmes. With many factors impacting forests (e.g., climate change, deforestation, social negotiability for forest management), higher forestry education has had to evolve to address these issues. The aim is to better prepare individuals to address these challenges.

Student enrolment in forestry-related programmes throughout the region has generally increased over the last decade. However, some participants reported drops in enrolment from students preferring to enter more environmentally focused fields of study, rather than forestry. Programmes and faculties are merging in universities to better incorporate conservation, ecological and natural resource-based courses and community-focused practices. More students are seeking post-baccalaureate education to gain a competitive advantage in the workforce.

The quality of education was found to be a topic of concern for many participants. International rankings, research competition, and lack of trained professionals are

impacting the quality of education in some universities. Professors are limited in number and are sometimes encouraged to focus energies on research and development, rather than student learning. Some students who wish to seek higher quality education face barriers due to finances, language, and curricula when applying to go abroad.

Student mobility is vitally important for providing students with additional experience and opportunities for a broader global understanding of forests and forestry. Faculty exchanges also help achieve these goals by allowing professors to gain a broader understanding of various learning and teaching styles to incorporate at their home universities.

If higher forestry education is to continue to change to incorporate the comprehensive nature of the field, programmes must be up-to-date with relevant topics that interest students and appropriately prepare them to address the sector's needs. Survey participants reported that students are seeking out environmental- and conservation-related programmes. New programmes are incorporating the larger scope of forest management by teaching students about the various practices used on the multiple forest resources. Universities are now offering programmes that can equip students to practice SFM in various ecosystem types. Merging of certain programmes was reported by some participants. While this may be useful to cover current forestry approaches, it is important to ensure that forest science and management still receive appropriate attention.

The formation of new forestry-related programmes has allowed students to choose among a broader selection of areas. However, it is important to ensure the quality of these programmes in order to increase capacity in the region. Developing effective and high quality courses that meet global and regional standards is important for resource sharing and international exchange. Adapting programmes to align with the transition of the forestry sector is important for both educating students and increasing research and development. However, many institutions have found it challenging to provide the quality of education necessary.

Students are most successful in small classroom settings with highly knowledgeable and appropriately trained instructors who encourage student interaction. This has been found to be a challenge for many institutions.

Many potential students face barriers to accessing high quality forestry education, although some government aid for economically disadvantaged students is available at most educational institutions. While the quality of teaching staff, courses, and other resources has increased in the region, it is important that some students experience international education that can enhance their domestic education. Student and faculty exchange can be an extremely valuable experience and an effective approach for increasing capacity in the region. However, language, differences in curricula, and finances can all be barriers to successful exchanges.

5.2 EFFORTS IN THE REGION AND RECOMMENDATIONS FOR THE FUTURE

Universities are working to develop more inclusive programmes for students that are more aligned with job requirements. Student and faculty member mobility are important ways for increasing capacity. To ensure that exchange programmes are effective, international collaboration and communication about courses and curricula are necessary. For students to learn abroad and continue education at their home universities, some standardization is necessary. Standardizing courses not only helps with exchange programmes, but can enhance the overall quality of learning materials and delivery methods, including e-learning. As one example of this, AP-FECM has developed free online courses focusing on sustainable forest management for students.

5.3 SOLUTIONS AND RECOMMENDATIONS FOR CAPACITY BUILDING

Higher forestry education in the AP Region is in transition. Changing economics,

policies, and public and environmental pressures are all directing higher forestry education onto a new path. Achieving the capacity to educate students through high-quality, accessible education that is globally relevant is the key to success.

5.3.1 COURSE RECOGNITION AND CURRICULA COLLABORATIONS

The survey participants expressed their desires to strengthen international relationships and collaborative efforts and to share curricula and resources. To increase educational capacity in forestry, it is important that universities are encouraged to develop more standardized courses or curricula and to mutually recognize regional courses to ultimately formulate a systematic SFM programme that can cover a range of topics and landscapes.

Standardizing courses can work to promote easier transfer of credits, as many universities offer similar programmes but with different standards of education and teaching. Collaborative efforts to create and share standards can help increase the capacity of higher forestry education in the AP Region. One way to work towards this is to undertake benchmarking exercises, such as that reported by the University of Canterbury, to compare curricula to similar programmes at several international universities. Reviews such as this should be conducted as a way to compare ideas and strategies for course and curricula development. Building from information gathered from highly-ranked forestry programmes allows those universities looking to strengthen curriculum an efficient way to do so.

Some AP universities are currently working to develop standardized regional curricula that incorporate the challenges faced by AP forests. Success in this endeavor would improve transfer credit recognition allowing student exchanges to run more smoothly. Regional cooperation allows the use of expertise from around the region to create high quality curricular material. This will, in turn, increase capacity and produce higher quality graduates better able to implement SFM.

5.3.2 DEVELOP ACCESSIBLE LEARNING

For those students and faculty that are not able to travel internationally, e-learning (online learning) has enabled access to material developed internationally. If financial obstacles cannot be overcome, free online courses in various aspects of forestry are being developed or are currently available for students to use at their leisure. Such courses are good ways for students to learn at their own pace and within their own schedule without travelling. Online courses can be updated regularly to ensure that the material is up-to-date to address the shifting nature of forestry and higher forest education.

The recent development of a series of SFM courses by the AP-FECM is an example of how universities are working in partnership to create high quality accessible education across the region. These courses provide a comprehensive understanding of SFM by incorporating the expertise of professors from several universities around the AP Region supported by APFNet. The courses range from economics to ecology of rehabilitation and plantation management. Within a year of the launch, the courses had attracted over 3,000 users and over 30,000 views from 91 economies. More information on these courses can be found at www.sfmcourses.com.

AP-FECM is currently supporting work to develop six additional tropical SFM courses. There are opportunities for further course development in the future.

5.3.3 INTERNATIONAL COOPERATION

A common pathway to success is shaped through international cooperation and collaboration. AP-FECM works to provide members with an open platform to share experiences, ideas, and developments through international exchange. This promotes international exchange through developing curricula, providing exchange opportunities, and collaborating on research. International exchange and cooperation has been successful in the past and should continue to be encouraged throughout the AP Region. Working on a global scale to combat challenges in

forestry can lead to the development of internationally recognized courses and programmes, as well as advance research. Most of the survey participants indicated plans to develop stronger international collaboration and exchange of students, faculty, and knowledge.

Student mobilization works to breach international borders and narrow the gap for resources and information. Students who go on exchange can learn through experience, gain possibly higher quality education, and return to their home university with their new knowledge. Learning abroad exposes students to various kinds of forests and forestry practices, allowing them to gain a broader and more comprehensive understanding of forestry. As reported in the survey, regional governments are working to establish scholarship programmes and other funding opportunities for students from lower income families and economies to travel internationally to learn at highly-ranked universities. Short-term exchange programmes, such the Vancouver Summer Program (VSP) at UBC, allow for ease of credit transfer. The VSP is attractive and useful for students looking for a brief experience abroad. Long-term exchange programmes are also available; however, curricula comparisons are necessary to ensure that credits being taken abroad can be used by students at their home university. UBC's 2+2/3+2 transfer programme with several Chinese universities, is an example of a longer-term study abroad programme, as is the recently developed joint master's programme by UPLB, IPB, and UPM. International collaborations and exchanges have become more popular through networking platforms and open lines of communication. To further enhance these activities, more communication among participants in the region must occur.

Faculty exchange can act as a platform for training, resource sharing, and knowledge exchange. Faculty who go abroad can learn and be exposed to new teaching styles, help develop new course materials, and share experience along with ideas on various teaching strategies. Faculty exchange can also promote joint research projects and programmes. Faculty members that share common research interests can connect and work collaboratively to develop new research projects.

Promoting research and development in forestry can boost economic growth and

lead to more successful implementation of SFM. Understanding the challenges and developing solutions on a regional scale can be done through resource sharing and networking.

5.4 CONCLUSION

Higher forestry education is of prime importance to ensure the sustainable use of forests that continue to face anthropogenic stresses, such as climate change, deforestation, and illegal logging. Higher forestry education must also adapt to meet these changing needs. International efforts are required for regional success in enhancing the capacity for higher forestry education in some economies in the AP Region.

This report has discussed some of the challenges faced by participants in the region, and offered some solutions to combat these challenges. Efforts must be directed to enhance the quality of student learning and to provide more accessible education through exchange, financial support, and online courses. Participating universities must work in cooperation with each other to develop standardized courses and curricula.

Higher forestry education has been changing; this transformation must continue in order to increase the economic, social, environmental, and political well-being of the AP Region. AP-FECM hopes to work closely with partners in the future to develop more solutions to aid in the capacity building process for all member universities.

APPENDIX 1

NUMBER OF FORESTRY-RELATED DEGREE PROGRAMME STUDENTS IN 2016

Economy	University	Undergraduate	Graduate	Total
Australia	Australian National University	12	45	177
	Murdoch University	0	19	
	Southern Cross University	15	0	
	The University of Melbourne	28	45	
	University of Sunshine Coast	0	13	
Bangladesh	Khulna University	200	30	674
	Sylhet Sciences and Technology University	190	30	
	University of Chittagong	175	49	
Cambodia	Prek Leap National College of Agriculture	43	590	830
	Royal University of Agriculture	107	70	
	Tbong Khmum Heng Samrin University	20	0	
Canada	Lakehead University	183	47	3,340
	University of Alberta	432	198	
	University of British Columbia	1020	260	
	Université Laval	379	128	
	Université de Moncton	39	6	
	University of New Brunswick	211	79	
	University of Northern British Columbia	130	0	
	University of Toronto	122	106	

Economy	University	Undergraduate	Graduate	Total
China	Anhui Agriculture University	2043	406	102,383
	Beijing Forestry University	2269	1306	
	Beijing University of Agriculture	1800	400	
	Central South University of Forestry and Technology	5569	627	
	China Agricultural University	2786	369	
	Fujian Agriculture and Forestry University	5462	822	
	Gansu Agricultural University	2564	557	
	Hainan University	5101	533	
	Hebei Agricultural University	3036	356	
	Henan Agricultural University	2659	325	
	Huazhong Agricultural University	3512	1979	
	Hunan Agricultural University	1786	445	
	Inner Mongolia Agricultural University	1827	150	
	Jiangxi Agricultural University	1420	310	
	Jilin Agricultural University	1215	228	
	Nanjing Agricultural University	3173	1149	
	Nanjing Forestry University	3941	1041	
	Northeast Forestry University	4711	1304	
	North West Agriculture and Forestry University	5384	2180	
	Shandong Agricultural University	3766	526	
	Shanxi Agricultural University	1687	281	
	Shenyang Agricultural University	1239	295	
	Sichuan Agricultural University	4500	640	
	South China Agricultural University	2365	562	
	Southwest Forestry University	3754	462	
	Xinjiang Agricultural University	1234	307	
	Yunnan Agricultural University	1891	398	
	Zhejiang Agriculture and Forestry University	3459	272	

Economy	University	Undergraduate	Graduate	Total
Chinese Taipei	Chinese Cultural University	232	0	2,161
	National Chiaiyi University	546	64	
	National Chung Hsing University	277	100	
	National Ilan University	212	25	
	National Pingtung University	278	35	
	National Taiwan University	235	157	
Indonesia	Bogor Agricultural University	1428	394	1,822
Japan	Chiba University	66		2,525
	Ehime University	55		
	Gifu University	160		
	Kagoshima University	56		
	Kindai University	110		
	Kochi University	90		
	Kyoto Prefecture University	26		
	Kyoto University	240	162	
	Kyushu University	40		
	Hokka do University	36		
	Iwate University	30		
	Mie University	58		
	Nagoya University	35		
	Nihon University	130		
	Niigata University	175		
	Okayama University	120		
	Osaka Prefecture University	50		
	Shimane University	85		
	Shinshu University	85		
	The University of Tokyo	79		
	Tokyo University of Agriculture and Technology	120		
	Tottori University	235		
	University of Miyazaki	50		
	University of Ryukyus	35		

Economy	University	Undergraduate	Graduate	Total
Japan	Utsunomiya University	32		
	Yamagata University	165		
Malaysia	Universiti Putra Malaysia	650	217	867
Mongolia	NFEC (5 universities)	295	65	360
New Zealand	University of Canterbury	94	29	123
The Philippines	Central Philippines State University	103		1,884
	Isabela State University	116	9	
	Mindanao State University	113	24	
	Nueva Viscaya State University	316	35	
	Pampanga State Agricultural University	60		
	University of the Philippines Los Banos	861	81	
	Visca State University	111	19	
Thailand	Kasetsart University	1370	219	3,031
	Maejo University	468	0	
	Sukhothai Thammathirt Open University	960	14	
USA (West)	California Polytechnic State University San Luis Obispo	151	9	2,261
	Humboldt State University	270		
	Oregon State University	831	221	
	University of Alaska	163		
	University of California Berkeley	40	6	
	University of Washington	437	133	
Vietnam	Ho Chi Minh University of Agriculture and Forestry	241	0	1,729
	Hue University of Agriculture and Forestry	114	0	
	Thai Nguyen University	660	0	
	University of Tay Bac	40	0	
	Vietnam National University of Forestry	545	129	
Total				124,131

APPENDIX 2

DEGREE PROGRAMME LIST - (I) FORESTRY

Economy	University	Programme Name	Level
Bangladesh	IFESCU	Forestry	Bachelor
			Master
Cambodia	RUA	Forest Resource Management	Bachelor
			Master
Canada de	Lakehead University	Forestry	Bachelor
			Master
	University of Alberta	Forestry	Bachelor
			Master
			Doctorate
	UBC	Forestry	Bachelor
		Forestry	Master
			MSc
			MASc
			Doctorate
		Sustainable Forest Management	Master
	Université Laval	Forest Operations	Bachelor
		Forest Management and Environment	Bachelor
		Forestry	Master
			Doctorate
	Université de Moncton	Forest Management	Bachelor
		Forestry	Bachelor
	University of New Brunswick	Forestry	Bachelor
			Master
			Doctorate

Economy	University	Programme Name	Level
Canada de	University of Toronto	Forestry Research	Master
			Doctorate
China	Anhui Agriculture University	Forestry	Bachelor
			Master
			Doctorate
	BFU	Forest Management Science	Master
			Doctorate
		Forestry	Bachelor
	Beijing University of Agriculture	Forestry	Bachelor
		Agricultural extension (Forestry)	Master
	Fujian Agriculture and Forestry University	Agronomy (Forestry)	Master
	Gansu Agricultural University	Forestry	Bachelor
			Master
	Guizhou University	Forestry	Bachelor
		Forest Cultivation	Master
	Henan Agricultural University	Forestry	Bachelor
			Master
			Doctorate
	Huazhong Agricultural University	Forestry	Bachelor
			Master
	Inner Mongolia Agricultural University	Forestry	Bachelor
			Master
			Doctorate
	Jiangxi Agricultural University	Forestry	Bachelor
			Master
			Doctorate

Economy	University	Programme Name	Level
China	Nanjing Forestry University	Forestry	Bachelor
			Master
			Doctorate
	Northeast Forestry University	Forestry	Bachelor
			Master
	Northwest A&F University	Forestry	Bachelor
			Master
			Doctorate
		Management of Agriculture and Forestry	Master
			Doctorate
	Shanxi Agricultural University	Forestry	Bachelor
			Master
			Doctorate
	Shenyang Agricultural University	Forestry	Bachelor
	Sichuan Agricultural University	Forestry	Bachelor
			Master
			Doctorate
	South China Agricultural University	Forestry	Bachelor
			Master
	Xinjiang Agriculture University	Forestry	Bachelor
			Master
Chinese Taipei	CCU	Forestry and Natural Conservation	Bachelor
	NCHU	Forestry	Bachelor
	NCU Forestry	Forestry and Natural Resources	Bachelor

Economy	University	Programme Name	Level
Chinese Taipei	NIU	Forestry and Natural Resources	Bachelor
	NPUST	Forestry	Bachelor
	NTU	Forest Resource and Conservation	Bachelor
Indonesia	Bogor Agriculture University	Forest Management	Bachelor
			Master
			Doctorate
	Hasanuddin University	Forestry	Master
	Lampung University	Forestry	Bachelor
	Lampung Mankurat University	Forestry	Bachelor
	Papua State University	Forestry	Bachelor
	Tanjungpura University	Forestry	Bachelor
	University of Jambi	Forestry	Bachelor
Japan	Kyoto University	Forest Resources and Society	Bachelor
			Master
			Doctorate
		Tropical Forest Resources and Environments	Bachelor
			Master
			Doctorate
		Forest Utilization	Bachelor
			Master
			Doctorate
Malaysia	Universiti Malaysia Kelantan	Forest Research and Technology	Bachelor
		Forest Research	Master
	Universiti Malaysia Sabah	Forest Plantation and Agroforestry	Bachelor
	UPM	Forest Management and Ecosystem Science	Master
			Doctorate

Economy	University	Programme Name	Level
The Phillipines	Central Mindanao University	Forestry	Bachelor
		Forest Resources Management	Master
	UPLB	Forestry	Bachelor
Sri Lanka	University of Sri Jayawwadenapura	Environmental Management and Forestry	Bachelor
Thailand	Kasetsart University	Forest Management	Bachelor
			Master
United States of America (West)	California Polytechnic State University, San Luis Opisbo	Forestry and Natural Resources	Bachelor
	Humboldt State University	Forestry	Bachelor
	Oregon State University	Forestry	Bachelor
	University of California - Berkley	Forestry	Master
	University of Washington - Seattle	Forest Resources	Master
Vietnam	Hue University	Forestry	Bachelor
			Master
			Doctorate
		Forest Resources Management	Bachelor
	Nong Lam University	Forestry	Bachelor
			Master
			Doctorate
	Thai Nguyen University of Agriculture and Forestry	Forest Resources Management	Bachelor
	Tay Nguyen University	Forestry	Master
			Doctorate
	VNUF	Forest Resources Management	Bachelor
			Master
			Doctorate
		Forest Inventory and Planning	Doctorate
		Forestry	Bachelor

DEGREE PROGRAMME LIST - (II) FOREST SCIENCE

Economy	University	Programme Name	Level
Australia	Australian National University	Forestry	Master
	Murdoch University	Environmental Management and Sustainability	Bachelor
		Sustainable Development	Bachelor
		Environmental Science	Bachelor
	Southern Cross University	Forest Science and Management	Bachelor
			Master
	University of Melbourne	Forest Science	Bachelor
		Forest Ecosystem Science	Master
			Doctorate
	University of the Sunshine Coast	Environmental Management	Bachelor
Bangladesh	Khulna University	Forestry Science	Bachelor
			Master
			Doctorate
	Sylhet Sciences and Technology University	Forestry Science	Bachelor
			Master
Cambodia	MUC	Forest and Environment	Bachelor
		Forest Botany	Bachelor
	NPIC	Forest Botany	Bachelor
	PNCA	Forest and Environment	Bachelor
	RUA	Forest Science	Bachelor
		Forest and Environment	Bachelor
	RUPP	Forest and Environment	Bachelor
		Forest Botany	Bachelor
	SRU	Forest and Environment	Bachelor
		Forest Botany	Bachelor

Economy	University	Programme Name	Level
Canada	Lakehead University	Forest Science	Doctorate
	University of Alberta	Forest Biology and Management	Master
			Doctorate
	UBC	Forest Science	Bachelor
	UNBC	Ecosystem Science and Management	Bachelor
			Master
		Natural Resources and Environmental Studies	Master
			Doctorate
	University of New Brunswick	Forest Ecosystem Management	Bachelor
		Environmental and Natural Resources	Bachelor
		Forest Engineering	Master
	University of Toronto	Forest Biomaterial Science	Bachelor
	University of Winnipeg	Forest Ecology	Bachelor
China	BFU	Prataculture	Bachelor
			Master
			Doctorate
		Forest Science	Bachelor
			Master
		Silviculture	Master
			Doctorate
	Fujian Agriculture and Forestry University	Forestry Science	Bachelor
	Gansu Agricultural University	Plant Pathology	Master
	Huazhong Agricultural University	Plant Science and Technology	Bachelor
	Jiangxi Agricultural University	Botany	Bachelor
			Master

Economy	University	Programme Name	Level
China	Nanjing Forestry University	Forest Engineering	Bachelor
			Master
		Forest Genetics and Tree Breeding	Master
		Forest Microbiology	Master
	Northeast Forestry University	Forest Engineering	Bachelor
			Master
	Northwest A&F University	Forest Engineering	Master
			Doctorate
	Shenyang Agricultural University	Silviculture	Master
	South China Agricultural University	Pratacultural Science	Bachelor
			Master
Indonesia	Bogor Agricultural University	Silviculture	Bachelor
		Tropical Silviculture	Master
			Doctorate
	Lambung Mangkurat University	Forest Science	Master
		Forest Science	Master
Japan	Kyoto University	Forest Biology	Bachelor
			Master
			Doctorate
		Forest Ecology	Bachelor
			Master
			Doctorate
		Forest Hydrology	Bachelor
			Master
			Doctorate

Economy	University	Programme Name	Level
Japan		Forest Biochemistry	Bachelor
			Master
			Doctorate
		Structure of Plant Cells	Bachelor
			Master
			Doctorate
		Forest Information	Bachelor
			Master
			Doctorate
		Silviculture	Bachelor
			Master
			Doctorate
Malaysia	UPM	Forestry Science	Bachelor
Mongolia	NFEC	Forest Science	Bachelor
		Forest Engineering	Master
			Doctorate
New Zealand	University of Canterbury	Forest Science	Bachelor
			Master
			Doctorate
		Forest Engineering	Bachelor
Thailand	Kasetsart University	Forest Engineering	Bachelor
			Master
		Forest Biology	Bachelor
			Master
		Wildlife and Range Science	Bachelor
		Silviculture	Bachelor
			Master
			Doctorate

Economy	University	Programme Name	Level
United States of America (West)	Oregon State University	Forest Engineering	Bachelor
		Natural Resources	Master
	University of Hawaii and Manoa	Natural Resources and Environmental Management	Bachelor
			Master
			Doctorate
	Washington State University	Natural Resource Science	Master
		Earth and Environmental Sciences	Bachelor
	California Polytechnic State University, San Luis Opisbo	Forestry Science	Master
Vietnam	Thai Nguyen University of Agriculture and Forestry	Silviculture	Bachelor
	VNUF	Silviculture	Bachelor
			Master
			Doctorate

DEGREE PROGRAMME LIST - (III) BIODIVERSITY AND CONSERVATION

Economy	University	Programme Name	Level
Cambodia	CARDI	Biodiversity and Conservation	Bachelor
	CSUK	Natural Resources Management	Bachelor
		Biodiversity and Conservation	Bachelor
	ERA	Natural Resources Management	Bachelor
	ITC	Natural Resources Management	Bachelor
	MUC	Natural Resources Management	Bachelor
		Biodiversity and Conservation	Bachelor
	NPIC	Natural Resources Management	Bachelor
	NUM	Natural Resources Management	Bachelor
	PNCA	Natural Resources Management	Bachelor
		Biodiversity and Conservation	Bachelor
	RUA	Natural Resources Management	Bachelor
		Biodiversity and Conservation	Bachelor
			Master
	RUPP	Natural Resources Management	Bachelor
		Biodiversity and Conservation	Bachelor
	SRU	Natural Resources Management	Bachelor
		Biodiversity and Conservation	Bachelor
	UBB	Natural Resources Management	Bachelor
		Biodiversity and Conservation	Bachelor
Canada	University of Alberta	Environmental and Conservation Sciences	Bachelor
	UBC	Natural Resources Conservation Science and Management	Bachelor
		Natural Resources Conservation Global Perspectives	Bachelor
		Natural Resources Management	Master
	University of Toronto	Forest Conservation	Master
		Forest Conservation Science	Bachelor
		Forest Conservation Arts	Bachelor
	UNBC	Natural Resources Management	Bachelor

Economy	University	Programme Name	Level
China	Anhui Agricultural University	Plant Protection	Bachelor
			Master
	Beijing University of Agriculture	Plant Protection	Bachelor
			Master
	BFU	Forest Conservation	Bachelor
			Master
			Doctorate
		Ecology	Master
			Doctorate
	Gansu Agricultural University	Plant Protection	Bachelor
	Guizhou University	Wildlife Protection and Utilization	Master
	Hainan University	Plant Protection	Bachelor
			Master
	Henan Agricultural University	Plant protection	Bachelor
			Master
	Huazhong Agricultural University	Plant Protection	Bachelor
			Master
			Doctorate
	Hunan Agricultural University	Plant protection	Bachelor
			Master
			Doctorate
	Inner Mongolia Agricultural University	Forest Resources Conservation and Recreation	Bachelor
	Jilin Agricultural University	Plant Protection	Bachelor
	Shanxi Agricultural University	Ecology	Bachelor

Economy	University	Programme Name	Level
China			Master
		Plant protection	Bachelor
			Master
	Shenyang Agricultural University	Forestry Management	Master
		Forestry Protection	Bachelor
	Sichuan Agricultural University	Forest Resources Protection	Bachelor
			Master
			Doctorate
	Yunnan Agricultural University	Plant Protection	Bachelor
			Master
			Doctorate
	Xinjiang Agricultue University	Forestry Protection	Bachelor
Indonesia	Bogor Agricultural University	Forest Conservation and Ecotourism	Bachelor
		Tropical Biodiversity and Conservation	Master
			Doctorate
Malaysia	UPM	Wildlife Ecology and Management	Master
			Doctorate
United States of America (West)	Humboldt State University	Natural Resources Management	Master
	Oregon State University	Forest Ecosystems and Society	Master
			Doctorate
	University of Alaska Fairbanks	Natural Resource Management	Bachelor
			Master
		Natural Resources & Sustainability	Doctorate
	University of Washington – Seattle	Environmental Science and Resource Management	Bachelor
Vietnam	VNUF	Natural Resources Management	Bachelor
		Natural Resources Management (Advanced)	Bachelor

DEGREE PROGRAMME LIST - (IV) URBAN FORESTRY

Economy	University	Programme Name	Level
Cambodia	RUA	Urban Forestry	Bachelor
			Master
Canada	UBC	Urban Forestry	Bachelor
China	BFU	Urban Forestry	Bachelor
Malaysia	UPM	Urban Forestry	Master
Vietnam	Hue University	Urban Forestry	Bachelor
	VNUF	Urban Forestry	Bachelor

DEGREE PROGRAMME LIST - (V) COMMUNITY-BASED FOREST RESOURCES MANAGEMENT

Economy	University	Programme Name	Level
Cambodia	CSUK	Social Forest and Community	Bachelor
	MUC	Social Forest and Community	Bachelor
	PNCA	Social Forest and Community	Bachelor
	RUA	Community Based Forestry	Bachelor
			Master
		Social Forest and Community	Bachelor
	RUPP	Social Forest and Community	Bachelor
	SRU	Social Forest and Community	Bachelor
	UBB	Social Forest and Community	Bachelor
Canada	University of Winnipeg	Forest Policy and Management	Bachelor
Malaysia	UPM	Community Based Forestry	Master
Thailand	Kasetsart University	Social Forestry	Bachelor
			Master
Vietnam	VNUF	Social Forestry	Bachelor

DEGREE PROGRAMME LIST - (VI) INTERNATIONAL FORESTRY

Economy	University	Programme Name	Level
Cambodia	RUA	International Forest Management	Bachelor
			Master
Canada	UBC	International Forestry	Master
Malaysia	Universiti Malaysia Sabah	International Tropical Forestry	Bachelor
	UPM	International Tropical Forestry	Master
Thailand	Kasetsart University	Tropical Forestry	Master

DEGREE PROGRAMME LIST - (VII) WOOD AND FOREST PRODUCTS

Economy	University	Programme Name	Level
Cambodia	RUA	Wood and Forest Products	Bachelor
Canada	UBC	Wood Products Processing	Bachelor
			Master
			Doctorate
	Université Laval	Wood Engineering	Bachelor
		Wood Science	Master
China	Beijing Lav University	Wood and Forest Product	Bachelor
	Nanjing Forestry University	Wood Science and Engineering	Bachelor
	Sichuan Agricultural University	Wood Science and Engineering	Bachelor
Chinese Taipei	NCU Wood	Wood-Based Materials and Design	Bachelor
Indonesia	Bogor Agricultural University	Forest Product Technology	Bachelor
Japan	Kyoto University	Wood Processing	Bachelor
			Master

Economy	University	Programme Name	Level
Japan			Doctorate
		Biomaterials Design	Bachelor
			Master
			Doctorate
		Fibrous Materials	Bachelor
			Master
			Doctorate
		Chemistry of Composite Materials	Bachelor
			Master
			Doctorate
		Chemistry of Biomaterials	Bachelor
			Master
			Doctorate
		Biomass Morphogenesis and Information	Bachelor
			Master
			Doctorate
		Active Bio-Based Materials	Bachelor
			Master
			Doctorate
		Sustainable Materials	Bachelor
			Master
			Doctorate
Malaysia	Universiti Malaysia Sabah	Wood Technology and Industry	Bachelor
	UPM	Wood Science and Technology	Bachelor
			Master
			Doctorate
Thailand	Kasetsart University	Wood Science and Technology	Bachelor
		Pulp and Paper Technology	Bachelor
		Forest Products	Master

Economy	University	Programme Name	Level
Vietnam	Nong Lam University	Forest Products Processing and Technology	Bachelor
			Master
			Doctorate
	VNUF	Wood Technology	Bachelor
			Master
			Doctorate

DEGREE PROGRAMME LIST - (VIII) ECONOMICS IN FORESTRY AND ENVIRONMENTAL SCIENCES

Economy	University	Programme Name	Level
Cambodia	RUA	Forestry Economics	Bachelor
			Master
Canada	University of Alberta	Forest Business Management	Bachelor
		Forest and Business Administration	Master
		Forest Economics	Master
			Doctorate
China	Beijing Forestry University	Forestry Economics	Bachelor
	Nanjing Forestry University	Forest Economics and Management	Bachelor
			Master
	Northeast Forestry University	Forest Economics and Management	Bachelor
			Master
	Northwest A&F University	Economics and Management of Agriculture and Forestry	Bachelor
	Sichuan Agricultural University	Economic Forestry	Bachelor
			Master
Malaysia	UPM	Economics in Forestry	Master
Vietnam	VNUF	Forestry Economics	Bachelor

DEGREE PROGRAMME LIST - (IX) WATER RESOURCES SCIENCES AND MANAGEMENT

Economy	University	Programme Name	Level
Cambodia	RUA	Watershed Management	Bachelor
			Master
Malaysia	UPM	Watershed Management	Master
Thailand	Kasetsart University	Watershed and Environmental Management	Bachelor
			Master
			Doctorate
USA	Humboldt State University	Watershed Management	Bachelor

DEGREE PROGRAMME LIST - (X) ECOTOURISM/ PARKS AND RECREATION

Economy	University	Programme Name	Level
Cambodia	CSUK	Ecotourism and Management	Bachelor
	MUC	Ecotourism and Management	Bachelor
	PNCA	Ecotourism and Management	Bachelor
	RUA	Ecotourism	Bachelor
			Master
	RUPP	Ecotourism and Management	Bachelor
	SRU	Ecotourism and Management	Bachelor
	UBB	Ecotourism and Management	Bachelor
China	Beijing Forestry University	Ecotourism	Bachelor
Indonesia	Bogor Agricultural University	Ecotourism and Environmental Services	Master
			Doctorate
Malaysia	UPM	Parks and Recreation Management	Bachelor
		Sustainable Recreation and Tourism	Master

Economy	University	Programme Name	Level
Malaysia			Doctorate
	Universiti Malaysia Sabah	Nature Parks and Recreation	Bachelor
Thailand	Kasetsart University	Parks Recreation and Tourism	Bachelor
			Master
			Doctorate

DEGREE PROGRAMME LIST - (XI) OTHER PROGRAMMES

Economy	University	Programme Name	Level
Cambodia	CARDI	Agroforestry	Bachelor
	CSUK	Agroforestry	Bachelor
		Forest and Law	Bachelor
	MUC	Agroforestry	Bachelor
		Forest and Law	Bachelor
	PNCA	Agroforestry	Bachelor
	RUA	Agroforestry	Bachelor
		Forest and Law	Bachelor
	RUPP	Agroforestry	Bachelor
		Forest and Law	Bachelor
	SRU	Agroforestry	Bachelor
		Forest and Law	Bachelor
	UBB	Agroforestry	Bachelor
		Forest and Law	Bachelor
Canada	Lakehead University	Environmental Management	Bachelor
	University of Alberta	Agroforestry	Master
	University of British Columbia	Geomatics for Environmental Management	Master
	University of Moncton	Agroforestry	Bachelor

Economy	University	Programme Name	Level
China	Anhui Agricultural University	Landscape Architecture	Bachelor
			Master
		Animal and Plant Quarantine	Bachelor
			Master
	BFU	Agrology	Master
			Doctorate
		Geographic Information System	Bachelor
			Master
	Beijing University of Agriculture	Landscape	Bachelor
		Landscape architecture	Bachelor
		Ornamental plants and horticulture	Master
	Gansu Agricultural University	Landscape	Bachelor
	Hainan University	Landscape Architecture	Master
	Henan Agricultural University	Landscape Architecture	Bachelor
			Master
			Doctorate
	Huazhong Agricultural University	Horticulture	Bachelor
			Master
			Doctorate
		Landscape Architecture	Bachelor
			Master
			Doctorate
	Hunan Agricultural University	Landscape	Bachelor
			Master
			Doctorate
		Animal and Plant Quarantine	Bachelor

Economy	University	Programme Name	Level
China	Inner Mongolia Agricultural University	Landscape architecture	Master
		Landscape	Bachelor
	Jiangxi Agricultural University	Landscape architecture	Bachelor
			Master
		Botany	Bachelor
			Master
	Shanxi Agricultural University	Landscape Architecture	Bachelor
			Master
		Plant quarantine	Bachelor
			Master
	Shenyang Agricultural University	Landscape	Bachelor
	Sichuan Agricultural University	Landscape architecture	Bachelor
			Master
			Doctorate
		Gardens	Bachelor
	South China Agricultural University	Landscape architecture	Bachelor
			Master
	Xinjiang Agriculture University	Landscape	Bachelor
		Landscape architecture	Bachelor
			Master
	Yunnan Agricultural University	Horticulture	Bachelor
			Master
		Gardens	Bachelor
			Master

Economy	University	Programme Name	Level
Japan	Kyoto University	Landscape Architecture	Bachelor
			Master
			Doctorate
		Erosion Control	Bachelor
			Master
			Doctorate
		Energy Ecosystems	Bachelor
			Master
			Doctorate
		Biosphere Informatics	Bachelor
			Master
			Doctorate
Malaysia	UPM	Bioresource and Technology	Master
			Doctorate
Thailand	Mejo University	Agroforestry	Bachelor
	Sukhothai Thammathirat Open University	Forest Resources and Environmental	Bachelor
			Master
Vietnam	VNUF	Agroforestry	Bachelor
		Environmental Science	Bachelor
		Land Management	Bachelor
		Landscape Architecture	Bachelor
		Agro-Forestry	Bachelor

APPENDIX 3

DEGREE PROGRAMME ENROLMENT - FORESTRY

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Bangladesh	IFESCU	Domestic Forest Resources Management	Bachelor	153	153	175
			Master			
Cambodia	RUA	Forest Resource Management	Bachelor	11	12	11
			Master	3	4	4
Canada	UBC	Forestry	Bachelor	120	152	277
		Forestry	Master	12	19	5
			MSc	95	81	77
			MASc	12	7	2
			Doctorate	123	137	133
		Sustainable Forest Management	Master	0	0	16
China	BFU	Forest Management Science	Master	11	21	18
			Doctorate	10	7	9
Chinese Taipei	CCU	Forestry and Natural Conservation	Bachelor	66	68	67
	NCHU	Forestry	Bachelor	65	78	70

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Chinese Taipei	NCU Forestry	Forestry and Natural Resources	Bachelor	47	50	46
	NIU	Forestry and Natural Resources	Bachelor	50	50	50
	NPUST	Forestry	Bachelor	58	70	75
	NTU	Forest Resource and Conservation	Bachelor	68	75	73
Indonesia	Bogor Agriculture University	Forest Management	Bachelor	80	111	104
			Master	21	30	17
			Doctorate	8	5	4
Japan	Kyoto University	Forest Resources and Society	Bachelor	0	5	4
			Master	0	4	2
			Doctorate	0	0	1
		Tropical Forest Resources and Environments	Bachelor	0	4	1
			Master	0	4	3
			Doctorate			
		Forest Utilization	Bachelor	0	4	5
			Master	0	4	4
			Doctorate	0	1	3

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Malaysia	UPM	Forest Management and Ecosystem Science	Master	0	0	14
			Doctorate	0	0	3
Philippines	UPLB	Forestry	Bachelor	375	335	925
Thailand	Kasetsart University	Forest Management	Bachelor	31	39	30
			Master	16	13	12
Vietnam	VNUF	Forest Resources Management	Bachelor	131	198	315
			Master	0	9	47
			Doctorate	0	0	14
		Forest Inventory and Planning	Doctorate	2	2	4
		Forestry	Bachelor	0	0	9
Total				1568	1752	2629

DEGREE PROGRAMME ENROLMENT – FOREST SCIENCE

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Australia	University of Melbourne	Forest Science	Bachelor	NA	0	28
		Forest Ecosystem Science	Master	30	36	45
			Doctorate			

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Forest Science	Bachelor	13	12	11
Canada	UBC	Forest Science	Bachelor	72	53	89
China	BFU	Prataculture	Bachelor	59	55	28
			Master	14	16	24
			Doctorate	7	4	8
		Forest Science	Bachelor	82	58	61
			Master	0	25	62
		Silviculture	Master	16	35	27
			Doctorate	15	18	8
Indonesia	Bogor Agricultural University	Silviculture	Bachelor	48	72	90
		Tropical Silviculture	Master	0	6	15
			Doctorate	0	5	3
Japan	Kyoto University	Forest Biology	Bachelor	0	2	4
			Master	0	4	3
			Doctorate	0	1	0
		Structure of Plant Cells	Bachelor	0	5	4
			Master	0	3	2
			Doctorate	0	0	1
		Forest Information	Bachelor	0	3	1
			Master	0	3	2
			Doctorate	0	1	0
		Silviculture	Bachelor	0	3	1
			Master	0	3	2
			Doctorate	0	0	0

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Malaysia	UPM	Forestry Science	Bachelor	280	240	240
Mongolia	NFEC	Forest Science	Bachelor	97	81	168
		Forest Engineering	Master	6	18	8
			Doctorate	3	5	2
New Zealand	University of Canterbury	Forest Science	Bachelor	76	90	71
			Master	13	15	9
			Doctorate	11	13	20
		Forest Engineering	Bachelor	20	26	23
Thailand	Kasetsart University	Forest Engineering	Bachelor	6	27	15
			Master	1	0	0
		Forest Biology	Bachelor	36	20	31
			Master	8	17	11
		Wildlife and Range Science	Bachelor	17	26	20
		Silviculture	Bachelor	24	45	36
			Master	4	14	8
			Doctorate	1	0	0
Vietnam	Thai Nguyen University of Agriculture and Forestry	Silviculture	Bachelor			
	VNUF	Silviculture	Bachelor	150	63	82
			Master	79	145	60
			Doctorate	1	13	2
Total				1189	1281	1325

DEGREE PROGRAMME ENROLMENT – BIODIVERSITY AND CONSERVATION

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Biodiversity and Conservation	Bachelor	7	6	4
			Master	5	3	4
Canada	UBC	Natural Resources Conservation Science and Management	Bachelor	159	290	367
China	BFU	Forest Conservation	Bachelor	26	9	31
			Master	12	26	34
			Doctorate	4	8	9
		Ecology	Master	16	29	33
			Doctorate	13	12	8
Indonesia	Bogor Agricultural University	Forest Conservation and Ecotourism	Bachelor	0	96	109
		Tropical Biodiversity and Conservation	Master	0	5	10
			Doctorate	0	11	2
Malaysia	UPM	Wildlife Ecology and Management	Master	0	0	2
			Doctorate	0	0	2
Vietnam	VNUF	Natural Resources Management	Bachelor	0	0	46
		Natural Resources Management (Advanced)	Bachelor	0	34	45
Total				242	529	706

DEGREE PROGRAMME ENROLMENT – URBAN FORESTRY

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Urban Forestry	Bachelor	2	3	2
			Master	6	6	4
Canada	UBC	Urban Forestry	Bachelor	0	0	34
China	BFU	Urban Forestry	Bachelor	0	0	23
Malaysia	UPM	Urban Forestry	Master	2	5	5
Vietnam	VNUF	Urban Forestry	Bachelor	58	50	83
Total				68	64	151

DEGREE PROGRAMME ENROLMENT – COMMUNITY-BASED FOREST RESOURCES MANAGEMENT

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Community Based Forestry	Bachelor	9	8	6
			Master	2	4	4
Canada	University of Winnipeg	Forest Policy and Management	Bachelor			
Malaysia	UPM	Community Based Forestry	Master	3	10	40
Thailand	Kasetsart University	Social Forestry	Bachelor	1	1	8
			Master	1	0	0
Vietnam	VNUF	Social Forestry	Bachelor	38	0	0
Total				54	23	58

DEGREE PROGRAMME ENROLMENT – INTERNATIONAL FORESTRY

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	International Forest Management	Bachelor	6	6	4
			Master	2	4	8
Canada	UBC	International Forestry	Master	0	0	11
Malaysia	UPM	International Tropical Forestry	Master	0	3	10
Thailand	Kasetsart University	Tropical Forestry	Master	0	3	5
Total				8	16	38

DEGREE PROGRAMME ENROLMENT – WOOD AND FOREST PRODUCTS

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Wood and Forest Products	Bachelor	12	10	7
Canada	UBC	Wood Products Processing	Bachelor	106	94	169
China	Beijing Forestry University	Wood and Forest Product		123	165	198
Chinese Taipai	NCU Wood	Wood-Based Materials and Design	Bachelor	25	28	26
Indonesia	Bogor Agricultural University	Forest Product Technology	Bachelor	80	81	88

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Japan	Kyoto University	Wood Processing	Bachelor	0	1	4
			Master	0	0	4
			Doctorate	0	1	1
		Biomaterials Design	Bachelor	0	3	4
			Master	0	3	4
			Doctorate	0	0	0
		Fibrous Materials	Bachelor	0	5	4
			Master	0	3	4
			Doctorate	0	0	0
		Chemistry of Composite Materials	Bachelor	0	4	4
			Master	0	4	4
			Doctorate	0	0	0
		Chemistry of Biomaterials	Bachelor	0	4	4
			Master	0	4	4
			Doctorate	0	1	1
Malaysia	UPM	Wood Science and Technology	Bachelor	0	160	160
Thailand	Kasetsart University	Wood Science and Technology	Bachelor	29	17	23
		Pulp and Paper Technology	Bachelor	30	33	38
		Forest Products	Master	2	2	7
Vietnam	VNUF	Wood Technology	Bachelor	193	26	30
			Master	6	27	0
			Doctorate	0	1	2
Total				606	677	790

DEGREE PROGRAMME ENROLMENT –ECONOMICS IN FORESTRY AND ENVIRONMENTAL SCIENCES

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Forestry Economics	Bachelor	5	4	7
			Master	2	3	3
China	Beijing Forestry University	Forestry Economics		106	205	256
Malaysia	UPM	Economics in Forestry	Master	2	5	6
Vietnam	VNUF	Forestry Economics	Bachelor	121	368	427
Total				236	585	699

DEGREE PROGRAMME ENROLMENT – RESOURCES SCIENCES AND MANAGEMENT

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Watershed Management	Bachelor	1	1	2
			Master	4	4	6
Malaysia	UPM	Watershed Management	Master	1	2	5
Thailand	Kasetsart University	Watershed and Environmental Management	Bachelor	18	28	21
			Master	15	8	10
			Doctorate	2	0	0
Total				41	43	44

DEGREE PROGRAMME ENROLMENT – ECOTOURISM/PARKS AND RECREATION

Economy	University	Programme Name	Level	Enrolment 2005	Enrolment 2010	Enrolment 2015
Cambodia	RUA	Ecotourism	Bachelor	7	6	7
			Master	3	4	5
China	Beijing Forestry University	Ecotourism		19	29	49
Indonesia	Bogor Agricultural University	Ecotourism and Environmental Services	Master	0	4	7
			Doctorate	0	1	4
Malaysia	UPM	Parks and Recreation Management	Bachelor	0	0	160
		Sustainable Recreation and Tourism	Master	0	0	7
			Doctorate	0	0	2
Thailand	Kasetsart University	Parks Recreation and Tourism	Bachelor	26	23	28
			Master	9	6	9
			Doctorate	0	2	3
Total				64	75	281

APPENDIX 4

NUMBER OF FORESTRY-RELATED FACULTY MEMBERS IN 2016

Economy	University	Number of Forestry Faculty
Australia	University of Melbourne	9
Bangladesh	IFESCU	30
Cambodia	RUA	34
Canada	Lakehead University	14
	UBC	63
	University of Alberta	17
	Université Laval	31
	Université de Moncton	15
	University of New Brunswick	24
	University of Northern British Columbia	13
	University of Toronto	12
China	BFU	801
Chinese Taipai	CCU	7
	NCHU	17
	NCYUF	12
	NCYUW	11
	NIU	11
	NPUST	9
	NTU	23
Indonesia	IPB	52
Japan	Kyoto University	69
Malaysia	UPM	60

Economy	University	Number of Forestry Faculty
Mongolia	NFEC	25
New Zealand	University of Canterbury	9
The Philippines	UPLB	60
Thailand	Kasetsart University	79
USA (West)	California Polytechnic State University San Luis Obispo	23
	Humboldt State University	10
	Oregon State University	185
	University of Alaska	28
	University of California Berkeley	20
	University of Washington	40
Vietnam	VNUF	46
Total		2,365

APPENDIX 5

TUITION FEES

University	GDP per Capita (USD)	Reported Tuition per Year (USD)
BFU	15400	1451.38
IPB	3346.50	800
IFESCU	1211.702	200
Kasetsart University	5816.40	866.66
Kyoto University	32477.20	9800
NFEC (Mongolia)	3967.829	794
RUA	1158.69	380
UPLB	2899.40	900
UPM	9766.20	1113.33
VNUF	2111.11	238
CCU	22294	3360
NCHU	22294	1112
NCYUF	22294	968
NCYUW	22294	1600
NIU	22294	1630
NPUST	22294	2671.80
NTU	22294	1835.06
UBC	43248.50	5097
University of Canterbury	37808	5000
University of Melbourne	56327.70	8000

APPENDIX 6

FORESTRY EDUCATION SURVEY

ASIA-PACIFIC FORESTRY EDUCATION COORDINATION MECHANISM

FORESTRY EDUCATION SURVEY

Asia-Pacific Forestry Education Coordination Mechanism (AP-FECM) aims to support the reform and improvement of forestry education in the AP region. In AP-FECM's work plan of next four-year term, a decision was made to survey the current capacity, status and development trend of the forestry education in the AP region. Through this survey, the AP-FECM will create a forestry education database, determine priority areas for teaching, explore strengths and opportunities, as well as generate content for the Annual Report of Forestry Education.

PART I CAPACITY OF CURRENT FORESTRY EDUCATION

1. University/Faculty:

2. Location (Economy/State/City):

3. General Information:

a. Total Number of students in school by September 2016

Education Level	Number of Students
Bachelors	
Masters	
PhD	
Diploma	
Certificate	
Total	

b. Total Number of faculty members by September 2016

Title	Number of Faculty
Professor	
Associate Professor	
Assistant Professor	
Lecturer	
Total	

c. Please provide education information of faculty members.

Title	Education Level			
	Doctorate (%)	Masters (%)	Baccalaureate (%)	Others (%)
Professor				
Associate Professor				
Assistant Professor				
Lecturer				

d. Please fill out the "Excel File 1- Faculty Information Sheet" as attached.

Note: This document is vitally important to the survey in forming a forestry expert's database. Collecting the background education and teaching specialty of each faculty member allows for a better understanding of the current forestry education capacity in each region.

4. Enrollment Information:

Undergraduate: Academic Year	Total Students	Domestic Students	International Students
2015/2016			
2010/2011			
2005/2006			

Graduate (Master and PhD):

Academic Year	Total Students	Domestic Students	International Students
2015/2016			
2010/2011			
2005/2006			

5. Numbers of graduates and employment rate in the last ten years

Year	PhD		Masters		Undergraduate		Diploma	
	No. of Graduation	No. of Employment	No. of Graduation	No. of Employment	No. of Graduation	No. of Employment	No. of Graduation	No. of Employment
2015								
2010								
2005								

6. List the percentage of your graduates who entered each of the following occupations upon graduation from your university for years of 2005, 2010 and 2015.

Academic Year	Masters/ PhD (%)	Managerial/ Professional foresters (%)	Forest technicians (%)	Skilled forest workers level (%)	Non forestry-related occupation (%)
2015					
2010					
2005					

7. Please list forestry-related programmes that are offered by your university as well as student enrollment and employment information.

Programme Name:

a) Domestic Forestry

b) International Forestry

c) Community Based Forest Resources Management

d) Urban Forestry

e) Biodiversity and Conservation

f) Forest Science

g) Wood/Forest Product

h) Economics in Forestry and Environmental Science

i) Water Resources Science and Management

j) Ecotourism/Parks and Recreation

k) Other: please provide programme name and details

Programme Name (a-j)	Level (Bachelor, Masters, or Doctorate)	Enrolment in 2015	Enrolment in 2010	Enrolment in 2005	Employment Rate in 2015	Employment Rate in 2010	Employment Rate in 2005

8. Average annual cost of attendance from 2005 - 2015 (Including tuition, room, books, computer equipment or other expense).

Please provide amount of the cost:

Academic Year	Undergraduate Domestic Students (USD)		Undergraduate International Students (USD)	
	Average Tuition Per Semester	Other Expense on Average Per Semester	Average Tuition Per Semester	Other Expense on Average Per Semester
2016/2017				
2010/2011				
2005/2006				

Academic Year	Graduate Domestic Students (USD)		Graduate International Students (USD)	
	Average Tuition Per Semester	Other Expense on Average Per Semester	Average Tuition Per Semester	Other Expense on Average Per Semester
2015/2016				
2010/2011				
2005/2006				

9. Please describe the average academic English level of undergraduate and graduate students from your institution.

Average undergraduate student English level: (X the box that applies)

English Level	
Beginner	
Intermediate	
Advanced	
Native Speaker	

Average graduate student English level: (X the box that applies)

English Level	
Beginner	
Intermediate	
Advanced	
Native Speaker	

Do you offer any forestry courses or programmes that are taught in English? If yes, please provide the course or programme information.

Yes	
No	

If Yes, please list the course(s) or programme(s) information:

Course Name	Course Level PhD, Masters, Undergrad	Origin of the Instructor	Percentage of course materials in English	Percentage of Assignments and Exams in English	Percentage of Instructor Speaking English during Lecture

10. How many students in your university join the international exchange programme or joint programme to study abroad?

Academic Year	Undergraduate Students	Graduate Students
2015/2016		
2010/2011		
2005/2006		

Is there any financial support for your students to study abroad?

Yes	
No	

If Yes, please list financial support options and estimated value:

11. How many faculty members in your university attend the faculty exchange programme abroad?

Academic Year	Study	Visiting Scholars	Sabbatical Leave	Others
2015/2016				
2010/2011				
2005/2006				

Is there any financial support for your faculty members to attend those exchange programmes abroad?

Yes	
No	

If Yes, please list financial support options and estimated value:

12. What are 3 significant strategic plans that are related to the development of forestry education at your university that will be used in the next five years?

Strategic Plans	
a.	
b.	
c.	

13. Are you familiar with the Sustainable Forest Management (SFM)

online programme (http://apfecm.forestry.ubc.ca/sfm-online-courses/) developed by participated universities of the AP-FECM? Have any faculty members or students used those online courses? Please provide feedback for this SFM online programme.

14. Please provide your thoughts on how AP-FECM can help to improve forestry education in your economy.

PART II DOMESTIC STATUS OF FORESTRY EDUCATION

1. Economy:

2. Student Information:

Institution Name	No. of Female Undergraduate Students	No. of Male Undergraduate Students	No. of Female Graduate Students	No. of Male Graduate Students

3. Information of education institutions that offer degrees in forestry-related majors (includes universities, colleges, training institutes, and vocational colleges, please feel free to add more rows).

(If you do not have exact numbers, please give your best guesses)

a. Number of students in forestry major divided by the total number of students.

b. Examples of forest-related majors include natural resource management, forestry economics, forest recreation and so on. Graduates from these majors often work in

the forestry industry.

4. Please provide a brief description of all forest-related majors offered in your economy other than your university (please feel free to add rows)

Name	Simple description	Which institute(s) offer this major?

5. Please estimate the percentage of students studying forestry and forest-related majors out of all higher education students in your economy.

Institution Name	No. of enrolled undergraduate students	No. of enrolled postgraduate students	No. of bachelor degrees issued annually	No. of master degrees issued annually	No. of PhD degrees issued annually	Average starting salary for bachelor degree holders (USD)	% of students in the forestry major (a)	No. of forest-related majors and % of students in these majors (b)

PART III CONTRIBUTION TO ANNUAL REPORT OF FORESTRY EDUCATION IN ASIA PACIFIC REGION

The publication of the Annual Report of Forestry Education in the Asia-Pacific region aims to improve forestry education in the AP Region by examining challenges faced by member universities and sharing successful experience. As the first and only comprehensive study on the status of Asia-Pacific forestry education, this report will also help to raise each member university's public and academic profile. Therefore, in accordance with the obligations of the AP-FECM membership, each member university is encouraged to contribute one or more articles on the following topics to be published in the annual report.

Please choose potential topics you will contribute: (X the box that applies)

Submission	
Challenges and solving strategies (decline of enrolment, poor preparation of new students, inadequate government support, lack of interest from general public, lack of resources, outdated curriculum, inappropriate design of major curriculum, lack of opportunities for hands-on experience and access to international education systems	
Analysis of Forestry Higher Education in your region	
Gaps between international and domestic forestry education	
Development strategies for forestry education in your region	
New initiatives to improve forestry education (education programme and research)	
Other:	
Other:	

Papers can be submitted through the Executive Office of AP-FECM by the end of November 2016.

APPENDIX 7

CASE STUDIES

I - UNIVERSITY OF CHITTAGONG, BANGLADESH

INCORPORATING NEW KNOWLEDGE BASES IN THE CURRICULUM OF PROFESSIONAL FORESTRY EDUCATION IN BANGLADESH

M. Al-Amin, Institute of Forestry and Environmental Sciences, University of Chittagong

Key Idea

The British colonial approach still forms the core of forest management of Bangladesh. However, recent policies affecting forest management require the incorporation of social aspects and considering the diverse human dimensions in the forest. This change has been driven by various international commitments, conventions and treaties. Updated forestry curricula are required to graduate individuals who will introduce new knowledge and technology into the forestry sector while retaining the authentic old knowledge base. The intent is to examine forestry education, forest policies, conventions and treaties on forestry and environment in Bangladesh from its inception to date, consider the new demands, and incorporate new areas of knowledge into the best on-going forestry education base to graduate students familiar with the current arena of world forestry science, but also meeting the needs of their home society.

ILLUSTRATIONS WITH EXAMPLE: IFESCU

The Institute of Forestry, University of Chittagong (IFCU) was established in 1976

within the Faculty of Science. The Institute was renamed as the Institute of Forestry and Environmental Sciences, University of Chittagong (IFESCU) in July 1996. The Institute is situated in the south campus of the University which is about 20 km north of Chittagong. The campus is located in valleys of the hills of the Sitakunda Range. The beauty and serenity of the environment makes it very conducive for effective learning and healthy living. The aims, objectives and programmes of IFESCU are:

a) to provide and promote facilities for graduate and postgraduate studies and research in Forestry and Environmental Sciences;

b) to provide teaching, training and guidance in order to prepare candidates for the degrees of B. Sc. (Hons.) in Forestry, B. Sc. (Hons), in Environmental Science, M.F. (Master of Forestry), M. Sc. in Forestry, M. Sc. in Environmental Sciences, M. Phil in Forestry, M. Phil in Environmental Sciences, Ph.D. in Forestry, and Ph.D in Environmental Sciences;

c) to promote and provide guidance to Forest and Environmental education and training at the undergraduate and post-graduate level in Bangladesh as and when needed;

d) to develop indigenous teaching materials in Forestry and Environmental Sciences in Bangladesh;

e) to provide courses of further study for those who are already engaged in forestry and environmental professions and in-service training for professional, diploma, and certificate holders;

f) to provide consultancy service and technical assistance as requested for by organizations engaged in forestry and environmental sciences;

g) to publish books, bulletins, journals, reports etc. in forestry and environmental sciences;

h) to organize domestic and international symposia, seminars, conferences, workshops, and training programmes in forestry and environmental sciences; and

i) to undertake research for the advancement of education in forestry and

environmental sciences.

Student enrolment at the pioneer forestry institute in Bangladesh is illustrated in Table 1. Recently two other universities in Bangladesh opened departments that also offer a forest science degree (Table 2).

Not all graduates are able to work in government forestry professional jobs; however, many of the graduates are now leading the forestry sector in Bangladesh. To allow graduates to find work in other relevant sectors, curricula need to be modified to fit the demand of the job market, both at home and abroad.

Way Forward

Bangladesh forestry education needs to incorporate following new knowledge area to cope with the present and anticipated future demands at home and abroad:

1. global climate change;
2. biodiversity conservation;
3. forest-people conflict management;
4. landscape-level restoration rather than forest restoration;
5. technological interventions in forest resource monitoring and assessment;
6. invasive species management;
7. carbon management and trading; and

panel wood and wood processing business interventions

Conclusion

Curricula development is an ongoing process for any educational institution. This accommodates new knowledge areas and helps prepare graduates. Recent job markets, corporate mechanisms, and blending knowledge protocols require

Table 1 Student statistics at IFESCU from inception to June 2014.

Students enrolled	Degree	Students			
		Male	Female	Foreign	Total
Graduates	B.Sc. (Hons.)	772	74	16	862
	M.Sc.	361	38	04	403
	M.Phil.	3	1	-	4
	Ph.D.	7	2	-	9
	Subtotal	1143	115	20	1278
Current students (Annual intake B.Sc. (Hons)- 40; M. Sc. - 40	B.Sc. (Hons.)	111	42	-	153
	M.Sc.	25	1	-	26
	M.Phil./PhD	15	02	-	17
	Subtotal	151	45	-	196
Total		1294	160	20	1474

Table 2 Student statistics for DFES, SUST and FWSD from inception to June 2014.

Students enrolled	Degree	Students	Annual intake
		Total	Total
Department of Forestry and Environmental Sciences at Sylhet Science and Technology University	B.Sc. (Hons.)	279	58
	M.Sc.	158	58
	M.Phil.	-	-
	Ph.D.	-	-
	Subtotal	437	116
Forestry and Wood Science discipline at Khulna University	B.Sc. (Hons.)	?	48
	M.Sc.	?	48
	M.Phil./PhD	-	-
	Subtotal	-	96
Sub professional level Diploma in Forestry	Diploma	535	50

refurbishing the current forestry curricula to address societal issues and incorporate new technologies at local and global scales.

II - ROYAL UNIVERSITY OF AGRICULTURE, CAMBODIA

CAPACITY BUILDING IN CAMBODIA

Dr. Von Monin, Faculty of Forestry Science, RUA

Forestry education in Cambodia is not very attractive to potential students because of issues in the past and present in forest management and administration. These issues have resulted in vast amounts of deforestation and forest degradation. Such issues are occurring primarily from illegal wood cutting in conservation or protected areas. Presently, these cases are unclear or unjustly addressed.

Currently, forestry education in Cambodia rarely attracts young people that are not environmentally minded or interested in naturalism. Consequently, enrolment has decreased. Current students are mostly dependent on individuals who apply from the Ministry of Education, Youth, and Sport (MOEYS). Students from MOEYS enter without doing an entrance examination.

Students graduating in forestry are concerned with obtaining a stable financial income. In addition, they also have a sense that to work in this field, they need to work physically at the field sites. The Cambodian government still has no clear policy to encourage the forestry sector, especially in forestry education. However, the government needs to have qualified young staff in this field. Another option is to develop resources to heighten interest in forestry education from both general private or public education providers to encourage proper long-term investments and decrease barriers to accessible jobs.

Forestry education in Cambodia has seen a lack of opportunities for hands-on experience and access to international education systems. This has led to poor quality administration and management since the field has slow movement and is considered

unstable. Many of the high quality and capable individuals in the forestry field do not want to work in forestry education due to low salaries, and so on.

GAPS IN CAMBODIAN EDUCATION

Forestry Education in Cambodia has undergone a series of reforms over the past four decades. This article examines temporal changes in forest resources and policies, the status of forestry, and challenges regarding SFM in Cambodia. Excessive logging, both in the past and currently, has badly affected the nation's forests and forestry education. However, adoption of government policies that have transferred more than three million ha of forest land to the Ministry of Environment has led to increases in SFM and increased the total forest area and growing stock. Forest degradation was ecologically and economically costly, and rehabilitation processes have become increasingly more expensive. The low quality and young age of the forest resources, loss of natural forests, and difficulties in afforestation and reforestation pose severe challenges for sustainable forestry in Cambodia and may affect forestry education. It is critically important for Cambodia to enhance forestry education through intensive cooperation, strengthened enforcement and educational programmes for protecting and restoring natural forests, narrowing the gap between domestic and international forestry education, and accelerating efforts to clarify and stabilize tenure arrangements in forestry education institutions.

One reason for the gap between international and domestic forestry education in Cambodia is instructor qualifications, which generally are below international standards. Another reason is the lack of government support for higher education. International groups sometimes overlook small universities in the developing economies. Help is needed in terms of consultation team support and networking within the region.

INITIATIVES IN CAMBODIA

Higher education has been facing fundamental changes, triggered by globalization

and global change, altered expectations of stakeholders and society from university graduates, and novel insights of educational sciences calling for a move from teaching to learning. Programmes of higher forest education have been challenged even more by changing societal demands and emerging issues, such as climate change, changing patterns of demands for ecosystem services, and novel resource governance systems. The development of forest sciences as well as of forestry curricula should adapt to, or even anticipate, those trends. Consequently development of forest sciences curricula should move towards:

- focusing on generic and methodical competences instead of content and descriptive approaches, enabling graduates to tackle novel, complex problems;
- competences to integrate and communicate knowledge across disciplinary borders and to analyze existing interactions; and
- new learning units addressing challenges such as climate change, adaptive ecosystem management, governance systems, gender issues, forests as source of energy, role of forests and forest products in rural development and poverty alleviation, as well as the assessment of other environmental and social impacts.

The task force on Education in Forest Sciences is an attempt to address the growing demand for coordination of research and education at the university level, improve educational practices, and to develop standards for education in forest sciences.

III - UNIVERSITY OF BRITISH COLUMBIA, CANADA

DEVELOPMENT OF 2+2/3+2 PROGRAMMES FOR DEGREE-SEEKING TRANSFER STUDENTS

Xinxin Zhu, Faculty of Forestry, University of British Columbia

Undergraduate transfer programmes (also referred to as “2+2”/”3+2” programmes) represent a very successful collaboration between the UBC Faculty of Forestry

and several Chinese forestry universities. Formal cooperation agreements with Nanjing Forestry University, Fujian Agricultural and Forestry University, Beijing Forestry University, and Zhejiang Agricultural and Forestry University have been approved by the Chinese Ministry of Education (MOE, China). These transfer programmes involve two or three years of post-secondary education in China, followed by programme completion at UBC. Successful graduates receive a UBC degree. Students in these programmes join one of the Bachelor of Science degree programmes at UBC in Forestry, Wood Products Processing, Forest Sciences, and Natural Resources Conservation. Considerable interest has been expressed with respect to formalizing a transfer arrangement with UBC's new Urban Forestry programme.

Since the first Chinese transfer student was accepted in 2008, over 315 students have successfully transferred to the UBC Faculty of Forestry from one of the partner universities in China. Due to a shift from a "2+2" to a "3+2" model, 2015 exhibited relatively low enrollment rates; however, the number of transfer students increased again in 2016 with 77 new transfer students, and we are currently welcoming 82 new students to join us in September 2017. There will be approximately 180 transfer students attending UBC Faculty of Forestry for the 2017-2018 academic year.

The Faculty of Forestry has taken many actions over the past 5 years to support the Chinese transfer students. In 2011, a Programme Coordinator position was developed in order to work more closely with the students and staff from our Chinese partner universities. We also developed and launched an introductory video lecture series that includes 20 modules covering a broad range of forestry and natural resource conservation topics. Since 2012, the Faculty has offered a 3-week summer orientation programme in order to help incoming Chinese transfer students become familiar with forestry issues within the context of British Columbia, adjust to life on campus, and promote academic integrity and cross-cultural understanding. Finally, a reading break volunteer programme has been established to help transfer students gain field work experience and enhance work safety in the field.

The transfer programmes have produced qualified graduates who are proficient in both Chinese and English and who are familiar with a broad range of disciplines including forestry and management, advanced wood products processing technology, and conservation. During the past few years, many outstanding students received scholarships due to their excellent academic performance. Since 2010, 118 transfer students have graduated. Roughly 30% of these students have continued their studies in graduate programmes across North America and Europe, while the remainder of the graduates chose to pursue their career in some aspect of the forestry and natural resource industry - among which approximately half work in Canada. Students who were, or are, currently enrolled in the programme strongly agree that it enabled them to develop international perspectives, obtain advanced knowledge, experience the learning atmosphere in an internationally renowned university, and pursue careers with high-quality job options in both Canada and China.

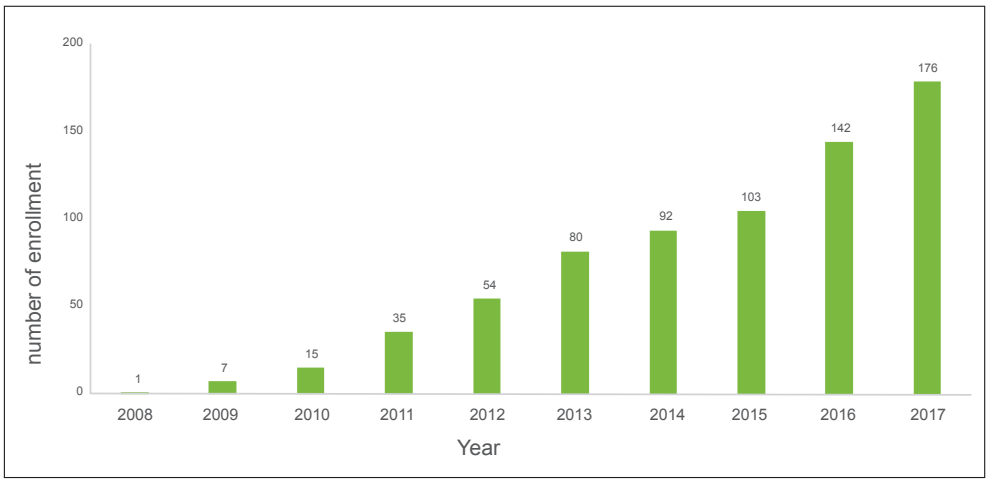

Figure 1. Enrollment of 2+2/3+2 transfer students since the 2008 academic year.

The "3+2" cooperative educational platform fully embodies the principle of keeping teacher-level cooperation as a priority. Since the cooperation was launched, UBC Faculty of Forestry has committed to helping partner universities improve their teaching and research abilities by introducing high-quality forestry

educational resources and concepts, actively carrying out joint personnel training, promoting capacity building, and recognizing the strengths and characteristics of each programme. Young faculty members from partner universities have studied at the UBC Faculty of Forestry as visiting scholars. They have been able to work with professors in similar study fields, conducting research and writing papers together, developing core courses within the transfer programmes, and learning interactive teaching strategies and skills through auditing courses at UBC. The Chinese partner universities have also arranged teachers to serve as assistants for UBC professors when they visit China to provide teaching sessions or research seminars. Through these opportunities, young faculty members get a chance to improve their professional English communication skills, and experience North American styles of teaching.

Through this collaboration, UBC Faculty of Forestry has obtained more diversity within its student body. The joint platform has attracted many outstanding students who are willing to dedicate their career to forest sciences, wood science and sustainability in both Canada and China. It has also opened more opportunities between the institutions regarding students, research and teaching exchanges. Through the platform, more innovative and excellent educational programmes have been developed. For example, the visiting students programme sponsored by the China Scholarship Council has provided learning abroad opportunities for excellent students from partner universities to study forestry courses at UBC. It has also helped the students to improve their cross-cultural understanding. In addition, UBC students have also been able to explore Chinese forestry through summer field school programmes which help them obtain international learning experience, increase their global awareness, and elevate their cross-cultural understanding.

In conclusion, the joint educational programme has a strong connection with sustainable development and ecological awareness in China, and will continue to play an active role in producing international biologists, foresters, and wood science personnel. The cooperative platform, not only enables UBC's educational concepts and models to be shared and practiced at Chinese partner universities, it

also has helped to cultivate excellent personnel, contributed to capacity building, and promoted joint education and research among the institutes.

IV - BEIJING FORESTRY UNIVERSITY, CHINA

ANALYSIS OF FORESTRY HIGHER EDUCATION IN CHINA, JAPAN, AND KOREA

Huanhuan Guo and Ye Yuan, Faculty of Forestry, BFU

Abstract: We analyzed the current situation of higher forestry education in China from structure, curriculum arrangement, delivery, and international communication, and then explored the main characteristics of higher forestry education in other Asian nations. Finally, we conclude with several suggestions for further developing higher forestry education in China.

Keywords: Forestry higher education; current situation; main characteristics; exception for future

Forestry higher education in China started at the beginning of 20th century. However, there was no specialized school teaching forestry in 1949, when the People's Republic of China was founded. After 1949, especially after the 'Reform and Opening', higher education in forestry has flourished. Forestry education in China has evolved considerably over the years but still faces some challenges.

1 Analysis of the Current Situation in China

1.1 Structure of Higher Forestry Education

With the development of forestry in China, higher forestry education is growing. According to data calculated by the Chinese Ministry of Education in 2011, 75 universities in China provided higher forestry education and 13,000 graduate students studied it (Li et al., 2011).

Some individuals believe that although the forestry education in China is progressing at a high speed, its scale is shrinking because the reform of higher education in 1999 failed to change the forestry education structure. Rather than fit education to the industrial structure it made the gap between education and practice larger, which made forestry higher education in China appear aimless (Guo et al., 2013). However, in others' opinions, this phenomenon is in response to the nature, from interest to public benefit, of forestry in China (Wang et al., 2014).

1.2 Curriculum Arrangement in Forestry Education

Forestry curricula consist of professional required courses, professional elective courses, public required courses, public elective courses and professional practice courses. Professional required courses occupy 50% of the curricula, while professional elective courses take up 20%-30%, and professional practice courses take up 10% (Zhao et al., 2014).

Chinese forestry curricula focus on the variety and depth of disciplines, but ignore pertinence and selectivity. It is difficult for students to choose the disciplines in which they are interested. Moreover, theory is separated from practice and the speed of forestry education development is unable to meet the needs of forestry and economic development (Li et al., 2011).

Curricula for graduate students involve practice courses and technical courses. Some educators point out the weakness of this system is that students do not have enough time to do independent learning and absorb knowledge from other disciplines (Zhao et al., 2014).

1.3 Educational Approaches

Chinese forestry education has two aims: (1) to develop forestry science to promote forestry sustainable development and accelerate ecological considerations; (2) to cultivate forestry talent along with innovation ability and practical skills to help improve society (Li et al., 2011).

Problems in education between theory and practice, between abstract goals

and specific measures, have not been solved completely. Current educational approaches are designed to cultivate specialized talents, but the current credit system makes some disciplines too structured to achieve this (Yang et al., 2000).

Although some discussion has been added to teaching approaches, methods where teachers lecture on their own is still the mainstream. Knowledge levels included in courses is lacking and consequently, the teaching efficiency is low. Students with different personalities receive the same courses and their learning may be limited. Last but not least, the examination approaches are tedious (Zhen et al., 1998).

1.4 Internationalization of Forestry Education

In recent years, universities in China that have forestry programmes have had positive exchange and other cooperation agreements with international forestry universities. For example, Northwest A&F University has cooperated with some foreign forestry universities to improve teaching skills. Nanjing Forestry University and the University of British Columbia have a student transfer programme it place. Also, the Chinese government offers scholarships to attract more foreign students to China (Wang et al., 2012).

2 Characteristics of Foreign Higher Forestry Education

2.1 Main Characteristics of Higher Forestry Education in Japan

There are three targets for higher Forestry education in Japan: cultivate talent, scientific research, and serve society. Japan would like to modify their forest environment and facilitate sustainable development. The key approach is to mix knowledge from different areas together to explore new territories, establish modern forest science research systems, and finally, provide variety and practical service for society. Japan reset their forestry curriculum following the 'Proposal for Forestry in 2000'. They distributed Forestry and subjects connected to Forestry programmes to Biology and Environment Science in order to expand Forestry students' horizons in environment and resources. The education approach focused

on a liberal education. A case in point is Hokkaido University, where its required courses include Forestry, Conversation of Water and Soil, Forestry Economics, and Harvesting. Elective courses cover Forest Protection, Wildlife, Forestry Machines, Civil Engineering and Chemical Process Engineering. Half of the courses offered need professors from other departments. Required courses cover a large area and the elective courses are free to choose (Peng et al., 2013, Liu et al., 2010).

2.2 Main Characteristics for Higher Forestry Education in Korea

Korea has no junior college for Forestry. Most universities include Forestry-related subjects in Agriculture, Environment and Resource Colleges in comprehensive universities. Only Kangwon National University and Kookmin University set up independent Forestry Colleges. In total, there are 18 universities who have forestry-related disciplines. Scholars in Korean Forestry comment that forest resources management arises from the desire to manage the forest efficiently. Korean forestry education emphasizes the significance of the forest's ecological functions and environment protection. The Forestry curricula differ among universities. Students are able to choose specialization areas freely and the alternative courses are adequate. Universities with Forestry programmes own multiple practice bases (i.e., research forests) and they have an institution to help discuss the construction of practice bases (Peng et al., 2010).

3. Forestry's Future in China

After analyzing the current situation in China and the reforms taking place in foreign nations, directions for development of Forestry education in China are:

1. Maintain the scale of forestry education: The number of individuals who have received technical secondary or higher forestry education is less than 20% in among forestry workers (Li et al., 2011). Students who majored in forestry have low recognition (Mei et al., 2012). This situation means that the education scale has failed to satisfy the need for knowledgeable workers. If the scale of Forestry education were to decrease, it would not benefit Forestry development in the

long term. Technical personnel with bachelor degrees will decrease. Even more, individuals who could earn master degrees and doctoral degrees in Forestry would go to other disciplines. In order to maintain Forestry education, endeavors from government and society in general need to be combined.

2. Change the education approach for graduate students: It is important to increase the number of graduate students in Forestry universities and colleges. Based on foreign universities' experience, there can be two approaches: research-based and course-based (Qu et al., 2008). The improvement of teachers is also critical, especially in enhancing the number of tutors to assure the "two-tutors" and "several-tutors" systems. Universities are required to improve the interaction between teaching and research and to include research education to improve graduate students' innovative abilities (Du et al., 2016).

3. Improve the structure of curricula: In order to promote the development of forestry education, curricula need to be modernized. Courses that address emerging industries, economic development, and people's livelihoods are required.

4. Improve the curricular system for higher forestry education: Forestry knowledge has been expanding rapidly and it covers a number of forestry-related systems as well as forests, Forestry graduates must master a comprehensive knowledge base. It has been a tendency to add non-forestry courses to curricula. In undergraduate forestry programmes, it is better for the volume of forestry knowledge to be reduced to allow an increase in liberal education to increase students' social awareness. Revising teaching methods to encourage more student engagement in classes is also essential. As well, students should be given the background necessary to start businesses and be offered the opportunity to adjust their education process (Ministry of Education, 2016).

5. Set up communication systems: Setting up communication systems requires two steps. First, encourage universities to cooperate with institutions and corporations. This aim can be done by building and sharing a practical basis for the educational programme and sharing teaching content and methods. Second, develop better

international linkages to attract more foreign students.

4 Conclusion

Forestry education is now undergoing tremendous change. It is not possible to develop a perfect forestry education model for different economies because of different economic situations, environments, cultures, and living standards. As a result, we would be better use our own conditions as a baseline, and then adapt from experiences learned from other economies to further develop higher education in Forestry.

V – NATIONAL TAIWAN UNIVERSITY, CHINESE TAIPAI

FORESTRY EDUCATION IN TAIWAN

Dr. Chun-Han Ko, Forestry Resources and Conservation, NTU

The Department of Forestry at National Taiwan University aims to provide the best scientific training programmes for its undergraduate and graduate students, producing graduates who are well prepared for pursuing advanced studies or careers in the natural resources management or forest products industries. In response to government policy, industry requirements, the trend of improving the global environment through promoting the use of renewable materials, and the ideals of technological development and environmental protection, the objectives of the bachelor and the master degree programmes are to provide well educated, highly trained and skilled professionals, with sound understanding of theory, technology, management, and the forest products industry.

There are 6 universities, including 8 faculties, offering forestry education in Taiwan: Chinese Culture University Department of Forestry and Nature Conservation (CCUF), National Taiwan University Forestry Resource and Conservation (NTUF), National Pingtung University of Science and Technology Department of Forestry (NPUSTF), National Chung Hsing University Department of Forestry (NCHU), National Ilan University Department of Forestry and Natural Resources (NIUF),

National Chiayi University Department of Forestry and Natural Resources (NCYUF), National Chiaiyi University Department of Wood-Based Materials and Design (NCYUW), and National Pingtung University of Science and Technology Department of Wood Science and Design (NPUSTW). All of these universities are located in different cities in Taiwan.

It is noteworthy that every university that offers a Forestry programme has their own experimental forest. The most famous experimental forest is NTUF's experimental forest that is located in central Taiwan and administratively belongs to Lugu, Shuili and Xinyi townships in Nantou County. The terrain rises from 220 m above sea level at the southern bank of the Jhuoshuei River to 3,952 m above sea level at the peak of Yushan Mountain, covering 32,781 ha and occupying about 1% of Taiwan Island. Not only is the Forest abundant in plant species, but also in wildlife. It is a veritable treasure house for academic research from various university departments and graduate institutes in biological sciences. Furthermore, it also provides a location for ecological education.

There are 43 professors, 29 associate professors, 24 assistant professors, 3 lecturers in Taiwan forestry education (Table 1). All of them have Ph.D. degrees, except for 3 lecturers at NIUF, NCYUW, and NPUSTW.

A total of 2037 undergraduates, 334 masters, 51 Ph.D. students study Forestry in Taiwan. The gender ratios for these groups are 1.18, 1.26 and 1.68, respectively (Table 2). Of the 6 universities, only CCUF has no graduate students.

Table 1. Number of faculty members in Taiwan forestry

	NCHU	CCUF	NTUF	NCYUF	NIUF	NCYUW	NPUSTF	NPUSTW	Total
Professor	8	1	10	4	6	6	4	4	43
Associate Professor	6	4	9	0	1	3	3	3	29
Assistant Professor	3	2	4	8	3	1	2	1	24
Lecturers	0	0	0	0	1	1	0	1	3
Total	17	7	23	12	11	11	9	9	

Table 2. Gender ratio of undergraduate and graduate students.

	Bachelor			Master			Doctor		
	Male	Female	ratio	Male	Female	ratio	Male	Female	ratio
NTUF	175	101	1.73	69	74	0.93	13	11	1.18
NCHU	151	123	1.23	28	22	1.27	19	8	2.38
CCUF	133	97	1.37	-	-	-	-	-	-
NIUF	123	88	1.40	14	11	1.27	-	-	-
NCYUF	91	99	0.92	30	18	1.67	-	-	-
NCYUW	188	175	1.07	13	10	1.3	-	-	-
NPUSTF	147	125	1.176	16	7	2.29	-	-	-
NPUSTW	96	125	0.77	16	6	2.67	-	-	-
Total	1104	933	1.18	186	148	1.26	32	19	1.68

The number of degrees granted in 2016 was 445 bachelors, 97 masters, and 6 Ph.D. The average starting salary for bachelor degree holders was 880-1330 USD per month. National Chiaiyi University Department of Wood-Based Materials and Design had the lowest starting salary of about 880 USD per month and National Taiwan University Forestry Resource and Conservation has the highest starting salary, about 1330 USD per month.

The average tuitions per semester are: Chinese Culture University Department of Forestry and Nature Conservation, 1680 USD; National Taiwan University Forestry Resource and Conservation, 917.529 USD; National Pingtung University of Science and Technology, 862.624 USD; National Chung Hsing University Department of Forestry, 556 USD; National Ilan University Department of Forestry and Natural Resources, 815 USD; National Chiayi University Department of Forestry and Natural Resources, 484 USD; and National Chiaiyi University Department of Wood-Based Materials and Design, 800 USD. The tuition at Chinese Culture University is higher than other universities because it is a private university.

All 6 universities all have basic and professional classes to educated forestry students. Freshman year courses include an in-depth study of fundamental

Table 3. Courses taught in English

School	Course Name
NTUF	Forest Climate & Practice Special Topics of Forest Environmental Measurement Biocomposite Material Science Exploring Taiwan: natural environment and resources Special Topics on Ecohydrological Researches Forest Environmental Physics Forest Management Quantitative Analysis
NCYUF	Introductory Forest Resources and Conservation in Taiwan
NIUF	Bioresources navigation and Narration
NPUSTF	Special Topics in Forest Management

subjects such as calculus, physics, chemistry, biology, etc. In the second year, a gradual emphasis is placed on professional subjects such as silviculture, forestry, dendrology, statistics, forest ecology, forest management, etc. The aforementioned are compulsory courses for the forestry department. Furthermore, there are also courses that are required for specialties including: statistics, organic chemistry, biochemistry, engineering, mechanics of materials, tree physiology and morphology, zoology, genetics, soil and water conservation, forest management, and forest recreation management.

The average academic English levels of undergraduate students are: NPUST and NIU, beginner; NCHU and NCYU, intermediate; and NTU advanced. In 2016, CCUF and NPUSTF had two students join the international exchange programme and NTUF and NCYUW had three. Table 3 lists courses that are taught in English.

To improve forestry education in the AP Region, we can contribute some potential reports for the Annual Report of Forestry Education in Asia Pacific Region, such as analysis of the higher forestry education in our area, development strategies for forestry education in our area, and new initiatives to improve forestry education.

VI - BOGOR AGRICULTURAL UNIVERSITY, INDONESIA

BOGOR AGRICULTURAL UNIVERSITY (IPB): ONE OF THE OLDEST FORESTRY FACULTIES IN INDONESIA

Professor Rinekso Soekmadi, Faculty of Forestry, IPB

Short Information

The Faculty of Forestry at Bogor Agricultural University (IPB) was developed in 1963. In 1969, the Faculty of Forestry IPB had two departments: the Department of Forest Management and the Department of Forest Product Technology. In conformity with the domestic education system for bachelor programmes in Indonesia, the study period for undergraduate programmes changed from 6 to 4 years. In 1982, a new department emerged within the Faculty of Forestry, the Department of Forest Resources Conservation and Ecotourism; in 2005 another department was established, the Department of Silviculture.

A graduate programme in Forest Management and Wood Sciences was started in 1978. In 1990, this study programme was changed to Forest Sciences. With the adoption of a new major-minor programme in 2005, the Faculty of Forestry had 4 undergraduate programme majors, 5 Master of Science programme majors, and 6 Doctorate programme majors, as follows:

1. Undergraduate programme majors:
   - Forest Management (MNH)
   - Forest Products (HH)
   - Forest Resources Conservation and Ecotourism (KSHE)
   - Silviculture (SVK)
2. Master of Science programme majors:
   - Forest Management Sciences (IPH)

- Forest Product Sciences and Technology (THH)
- Conservation of Tropical Biodiversity (KVT)
- Management of Ecotourism and Environmental Services (MEJ)
- Tropical Silviculture (SVK)

3. Doctorate programme majors:

- Forest Management Sciences (IPH)
- Forest Product Sciences and Technology (THH)
- Conservation of Tropical Biodiversity (KVT)
- Management of Ecotourism and Environmental Services (MEJ)
- Tropical Silviculture (SVK)

All study programmes within the Faculty of Forestry have been accredited by the National Accreditation Board (BAN – *Badan Akreditasi Nasional*).

The Faculty of Forestry has long experience with overseas forestry students from several universities, such as Kasetsart University (Thailand), Kangwoon University (South Korea), University Putra Malaysia (UPM), Göttingen University (Germany) sending students to do practical work in the university forest and the state forest enterprise in Jawa (Perhutani).

Higher Forestry Education in Indonesia

The Forestry programme has strong relationships with forestry-related businesses in forest management and the forestry industry. Over the past decade, forest concessions have been decreasing in line with population growth and regional development. Millions of ha of mostly degraded forest land have been converted to other purposes, such as oil palm plantations, settlement, and agriculture. Simultaneously, the timber supply from natural forests as well as from plantations has been reduced tremendously. To fulfill demands for timber, community forests

and village forests are developing rapidly; now almost 2/3 of the timber is supplied by such forests. As a result, there is no longer good opportunities for new graduates to get jobs the in forestry sector. As well, salaries in the forestry sector are less competitive than other job opportunities. Consequently, there has been a decline in the number of students entering forestry programmes over this period.

Last year, less than 25% of newly enrolling students selected the Faculty of Forestry as their first choice. In 2017, the number increased to about 40%. This is probably because of the demand for foresters in oil palm plantations is increasing, particularly for establishment, management, and evaluation of high conservation areas that are required to be set aside within the plantation areas.

New Initiatives

1. In order to meet the knowledge required in forestry jobs, the Faculty of Forestry is planning to develop thematic short training courses on HCV (high conservation value), GIS (geographical information system), post mining reclamation, wildlife breeding in captivity, and other topics that are needed by market. The courses will be open to new bachelor graduate from the Faculty of Forestry.

2. The Faculties of Forestry IPB, UPM (Malaysia) and Forestry UPLB (the Philippines) are developing a joint master programme in Tropical Forest Biodiversity and Conservation. At present, the universities are developing the curriculum and the mechanisms for student and/or lecturer mobility during the programme. Workshops in Bogor (2016) and Manila (2017) have been conducted to share experiences on conducting joint programmes. A forthcoming workshop will be held in the Philippines to agree upon the curriculum and the system.

VII - KYOTO UNIVERSITY, JAPAN

FOREST AND FORESTRY EDUCATION IN JAPAN: AN OVERVIEW

Professor Mamoru Kanzaki, Division of Forest and Biomaterials Science, Graduate

School of Agriculture, Kyoto University

Origin of Forest Science Education in Japan

In 1882, the Tokyo School of Forestry was established and forestry education started in Japan. The school contributed to the introduction of a German-style forest management system to Japan. In 1890, the school was integrated into Tokyo Imperial University as one of the colleges. Subsequently, agriculture and forestry schools were established in many prefectures, and these developed into the current forest education programmes in local universities. In 1919, a Faculty of Agriculture was established at Tokyo Imperial University (currently, the University of Tokyo) (University of Tokyo, 2017 & Tokyo University of Agriculture and Technology English Guidebook, 2016) and, in that same year, a Faculty of Agriculture was also established at Kyoto Imperial University (currently, Kyoto University).

Education in High Schools and Colleges/Institutes

Seventy-two high schools have forest and forestry education programmes and 4,978 students (0.15% of the total) were enrolled in the programmes in 2017. Among the 1,728 students who graduated from these forestry education programmes in 2013, 11% obtained forest-related jobs, 53.5% obtained non-forest related jobs, and 32.9% advanced to higher education (Inoue et al., 2014). Six forestry or agricultural and forestry colleges have been established by prefectural governments. These colleges are under the control of the Ministry of Agriculture, Forestry and Fisheries and provide the practical education required to be a forest manager. Total annual enrollment and graduates are about 85 (Table 1).

Education in Universities

Higher-education forest programmes in Japan are provided by at least 25 governmental/prefectural universities and three private universities. (See the

Table Information pertaining to educational institutions that offer degrees in forestry-related majors. All of the universities offer degrees up to the doctoral level. In universities marked by an asterisk (*), master's course student enrollment is nearly equal to that of undergraduate course enrollment. In the other universities, graduate school capacity is smaller than that for undergraduates. These 19 universities jointly established six united graduate schools of agriculture and are providing forest and forestry programs.

Institution Name **(NU): National and Public Univ.** **(PU): Private Univ.**	No. of enrolled undergraduate students	No. of bachelor degrees issued annually	% of students in the forestry major (a)	No. of forest-related majors (b)
Hokkaido University * (NU) Faculty of Agriculture,Department of Forest Science	36	36	100	36
Iwate University (NU) Faculty of Agriculture,Department of Forest Science	30	30	100	30
Yamagata University (NU) Faculty of Agriculture,Department of Food, Life and Environmental Sciences	165	165	15	25
Utsunomiya University(NU) Faculty of Agriculture,Department of Forest Science	32	32	100	32
Chiba University (NU) Faculty of Horticulture,Environmental Science and Landscape Architecture Course	66	66	50	33
The University of Tokyo * (NU) Faculty of Agriculture,Environmental and Resource Sciences Course	79	79	30	24
Tokyo University of Agriculture and Technology (NU) Faculty of Agriculture,Department of Ecoregion Science	83	83	30	25
Tokyo University of Agriculture (PU) Faculty of Regional Environment Science,Department of Forest Science	120	120	100	120
Nihon University (PU), College of Bioresource Sciences,Department of forest Science and Resources	130	130	100	130
Niigata University (NU) Faculty of Agriculture,Forest Science and Engineering Course	175	175	5	9
Shinshu University(NU) Faculty of Agriculture,Department of Agricultural and Life Science,Division of Forest and Environmental Symbiosis Science	85	85	25	21
Shuzuoka University(NU) Faculty of Agriculture, Department of Bioresource Sciences	70	70	30	21
Gifu University(NU) Faculty of Applied Biological Sciences	160	160	5	8
Nagoya University * (NU) School of Agricultural Sciences,Department of Bioenvironmental Sciences	35	35	50	18
Mie University (NU) Faculty of Bioresources,Department of Sustainable Resource Sciences	58	58	30	17

Institution Name **(NU): National and Public Univ.** **(PU): Private Univ.**	No. of enrolled undergraduate students	No. of bachelor degrees issued annually	% of students in the forestry major (a)	No. of forest-related majors (b)
Kyoto University * (NU) Faculty of Agriculture, Department of Forest and Biomaterials Science	60	60	100	60
Kyoto Prefecture University (NU) Faculty of Agriculture,Department of Forest Science	26	26	100	26
Osaka Prefecture University (NU) School of Life and Environmental Sciences,Department of Environmental Sciences and Technology	50	50	10	5
Kindai University (PU) Faculty of Agriculture	110	110	10	11
Okayama University (NU) Faculty of Agriculture,Course of Environmental Ecology	120	120	10	12
Tottori University(NU),Faculty of Agriculture	235	235	10	24
Shimane University (NU) Faculty of Life and Environmental Science,Department of Agricultural and Forest Sciences	85	85	30	26
Ehime University(NU) Faculty of Agriculture,Department of Biological and Environmental Science,	55	55	25	14
Kochi University(NU) Faculty of Agriculture and Marine Sciences,Department of Agriculture, Forestry, Bioresource and Environmental Sciences	90	90	25	23
Kyushu University*(NU),Faculty of AgricultureAgro-environmental Sciences,Forest Environmental Sciences	40	40	100	40
University of Miyazaki(NU),Faculty of Agriculture, Department of Forest and Environmental Sciences	50	50	100	50
Kagoshima University(NU) Faculty of Agriculture,Department of Environmental Sciences and Technology,Forest Science Course	56	56	30	17
University of the Ryukyus (NU) Faculty of Agriculture	35	35	30	11
University total		28 universities		868
Gunma Prefectural Institute of Agriculture and Forestry (Diploma)	20	20	50	10
Nagano Prefectural Institute of Forestry (Diploma)	20	20	100	20
Gifu Academi of Forest Science and Culture (Diploma)	20	20	100	20
Shizuoka Prefectural Agriculture and Forestry College (Diploma)	100	100	10	10
Kyoto Prefectural Institute of Forestry (Diploma)	20	20	100	20
Shimane Prefectural Institute of Agriculture and Forestry (Diploma)	10	10	50	5
Diploma total		5 institutions		85

table at the end of this case study.) In most cases, the forest science programme is an independent programme under the Faculty/Graduate School of Agriculture, Life Sciences, Natural Resource, and/or Environmental Sciences. The number of students enrolled in these programmes, 868, accounted for 0.14% of the total enrollment (617,507) in undergraduate courses in 2015 (Ministry of Education, 2017).

Currently, higher education in forest science covers basic sciences such as ecology, environmental science, molecular biology, and bio-chemicals, extending to advanced materials science, and to more applied sciences directly related to silviculture and the wood industry.

All of the universities offer degrees up to the doctoral degree. In universities such as the University of Tokyo, Kyoto University, and Hokkaido University, the enrollment in master's courses is nearly equal to the enrollment in undergraduate courses. At the other universities, graduate school capacity is smaller than that for undergraduate programmes. These 19 universities have jointly established six united graduate schools of agriculture and are providing forest and forestry programmes.

University Forest Network

Twenty-seven universities own 75 university forests used for educational and research purposes in Japan. These university forests were established as a university forest network (Japanese Association of University Forests) in 1951 and this association currently promotes collaboration in education and research (Japanese Association of University Forests, 2017). Field practice courses using the network have been established with a credit transfer system. Recently, the university forests of nine of these universities were designated as a Joint Usage/Research Center by the Ministry of Education (MEXT), and obtained a budget to improve facilities and the management of forests, with the aim of promoting collaborative education and research.

Certification of Educational Programmes by JABEE

The Japan Accreditation Board for Engineering Education (JABEE) was established in 1999 for the purpose of promoting professional education and to support the development of international professionals (Japan Association for Forest and Natural Environment Engineering Education, 2017). JABEE, as a third-party accreditation body, accredits professional education programmes in higher education institutions, facilitating the development of professionals with benchmarks required by society by means of the JABEE Accreditation Criteria, which are equivalent to those recognized internationally. In 2004, the forest education courses/departments of Utsunomiya, Chiba, and Niigata Universities were certified by JABEE, and Iwate and Shizuoka Universities were certified later. However, most of the other universities are not guaranteed to have their programmes certificated by JABEE because many graduates do not obtain careers as forestry professionals.

Job Opportunities

The percentage contribution of forestry to the GDP of Japan was only 0.04% in 2015 (Forestry Agency, 2015) Even including the wood and paper/pulp industries, it accounted for less than 0.7% of the GDP. Therefore, graduates of forest and wood-related programmes are absorbed by various sectors of industry, including forestry, paper and pulp, housing, trading, banking, computer software, and others. Most of the provincial forest officers and Forest Agency staff are recruited from forest-related departments and programmes of universities. Holders of doctorate degrees tend to obtain positions as researchers in government and enterprise, but it is rather difficult for young researchers to obtain a permanent position. Because of the downsizing of universities and institutions in Japan, young researchers are finding it difficult to obtain permanent research or faculty staff positions. They are often required, repeatedly, to take unstable, fixed-term contracts. This difficult situation is not only the case in the forest and forestry sector but is common to

every field within the sciences. Therefore, most students who have finished a master's programme prefer to obtain a job in enterprise or government sectors. Consequently, it has become rather difficult to fill the capacity of the doctoral programmes in universities.

Downsizing of Universities

In 2004, all of Japan's National Universities were incorporated, becoming "National University Corporations". Because of financial problems, the university corporations are reducing the number of faculty staff. Additionally, a reduction in the number high school students has caused a downsizing of universities (Centre for National University Finance and Management, 2008). Because of this downsizing, it is becoming difficult to maintain a sufficient number of faculty for offering forestry courses in departments that have smaller numbers of faculty members, especially in local universities. In the near future, it is inevitable that the higher education institutions of forest and forestry science will be reorganized and that the number of universities able to provide a forestry programme will be reduced.

The Japanese government also plans a drastic reformation of Japan's 86 National Universities. All National universities in Japan will be categorized into one of three new categories (Department of Education and Training, 2015):

i. Universities with world-class teaching and research,

ii. Universities with world-class teaching and research in specific fields, and

iii. Universities contributing to the revitalization of the local economy.

As most of the forest and forestry-related programmes are provided by 25 National universities, the impact of this policy on forestry education will be large.

Internationalization

One of the strategies used by universities in Japan to cope with a declining birthrate

is to internationalize universities, whereby increasing numbers of international students are accepted. MEXT started the Global 30 programme in 2009 (National Institute for Educational Policy Research: Higher Education, 2017 & National Institute for Educational Policy Research: International Student Policy of Japan, 2017), and 13 universities have established courses taught in English under this programme (Global 30, 2017). Among the 13 universities, the University of Tokyo, and Tsukuba, Nagoya, Kyoto and Kyushu Universities have forest and forestry programmes. These form a part of MEXT's plan to increase the number of international students in Japan to 300,000 by 2020.

Beginning in 2011, MEXT launched the Re-Inventing Japan Project, and support for various short-term exchange programmes and double-degree programmes including in-bound and out-bound students was established (Re-Inventing Japan Project, 2017). By implementing this programme, eight projects that include forest and forestry major courses were established at six universities. For example, Kyoto University established double master degree programmes in agricultural and forestry majors with Kasetsart University, Gadjah Mada University, Bogor Agricultural University, and Bandung Technology University (Kyoto University, 2017). Kyoto University accepted 16 students from the partner universities and sent four Kyoto students to these universities under this programme from 2014 to 2016 and the number is increasing.

Future Contributions of Japanese Universities to the AP Region

Universities in Japan can provide a high level of education, with a sufficiency of facilities. Further acceptance of international students, especially from the AP Region, will be available using the foundational system prepared during the G30 and Re-Inventing Japan projects.

We can provide a unique programme of study using our diverse forest types, from subtropical to boreal. Our University Forest Network can provide excellent field practice facilities. Our long history of forestry and a community/private forest

management system in collaboration with the government sector provide good examples of joint forest management.

On the other hand, the number of scholarships available for international students is still limited and needs to be expanded using the university budget and private and governmental financial support. The limited number of international faculty is also a problem that needs to be addressed for the further internationalization of Japan's universities.

VIII - ANALYSIS OF 5 MONGOLIAN FORESTRY INSTITUTIONS, MONGOLIA

FORESTRY EDUCATION IN MONGOLIA

Dr. Baatarbileg Nachin

Introduction:

Prior to 1990, most forestry professionals in Mongolia were trained in Russia, Poland, Bulgaria and Romania. Professional forestry education in Mongolia began in 1985 with 4.5-year B.Sc. and 6-year M.Sc. programmes in forestry at the National University of Mongolia (NUM) and in wood industry at the Mongolian Polytechnic University. Darkhan College offers a B.Sc. course in nature protection for a small number of students. NUM has averaged 20-30 forest engineering graduates per year, but only about a third of these have entered the forestry and natural resource sector because of very limited job opportunities. In addition, at one time there were as many as 4 sub-professional and 5 technical training schools offering 3-year technical diplomas. These schools graduated about 20 students a year from 1985 until they were terminated in 1994. In Mongolia, there are a few universities majoring in Forestry and Forest sciences. In the last 3-5 years, Mongolia has been conducting higher education reform, specifically in the state owned universities. In some universities, departments related to Forestry, Forest

Science and Forest Production are combined with other fields of natural sciences. Further challenges faced by forestry-related higher institutes include outdated curriculum design and delivery, lack of networking among those universities, and disconnection between forestry education and the forest industry. As of September 2016 there were 5 Universities offering forestry-related education in the economy. However, they have different department names. These are:

- Department of Environment, Forest Engineering, National University of Mongolia (DEFE, NUM),
- Department of Ecology, Mongolian University of Life Sciences (DE, MULS),
- Darkhan branch of Mongolian University of Life Sciences (Darkhan, MULS),
- Department of Wood processing technology, Mongolian University of Science and Technology (DWPT, MUST),
- Department of Horticulture, International University of Ulaanbaatar (DH, IUU)

A survey of the National forestry education status in Mongolia was carried out in September and October 2016 by the National Forestry Education Consortium (NFEC), Mongolia based on the questionnaire of Asia Pacific Forestry Education Coordination Mechanism (AP-FECM). Five institutions responded to the questionnaire. This report contains a review of current forestry education status in Mongolia and analyzes potential developments and changes in the forestry education sector.

Teaching capacity:

Among the 5 universities who are offering Forestry education in Mongolia, there are 3 full-time Professors. Associate Professors and Lecturers predominate, with 5 of Senior and Assistant Lecturers (Figure 1). In the last ten years, the number of faculty members who have studied abroad have increased. These faculty members earned Ph.D. degrees from South Korea, Czech Republic, Russia, USA, Germany, and Japan.

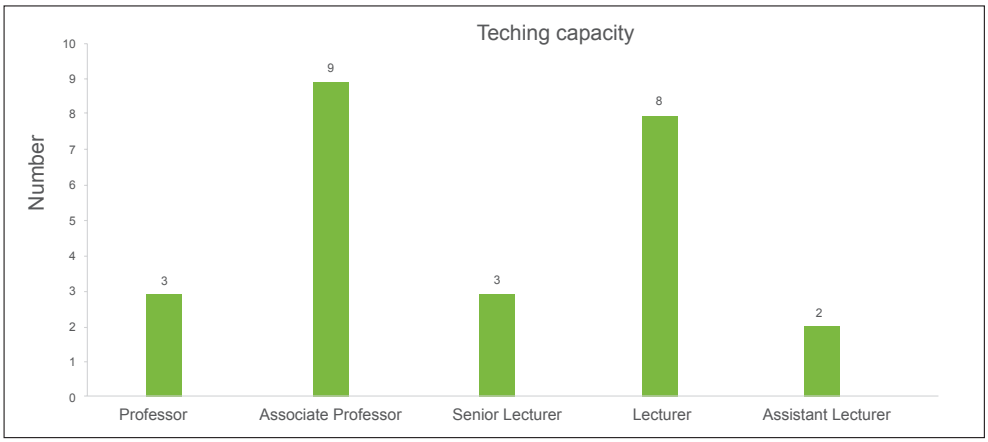

Figure 1. Information on Faculty members in 5 universities.

Undergraduates and Graduates:

There were 474 undergraduate students in the 2005/2006 academic year, 396 in 2010/2011 and 371 in 2015/2016 from the 5 universities surveyed (Figures 2 and 3). Among the sampled universities, the doctoral degree was not offered in Darchan branch of MULS and IUU. IUU offered a special programme that focused on short-term courses for certificate-based training. There are 600 individuals who have received this certificate. Graduation with bachelor degrees is gradually decreasing and graduation with master and doctorate degrees is slightly increasing or constant.

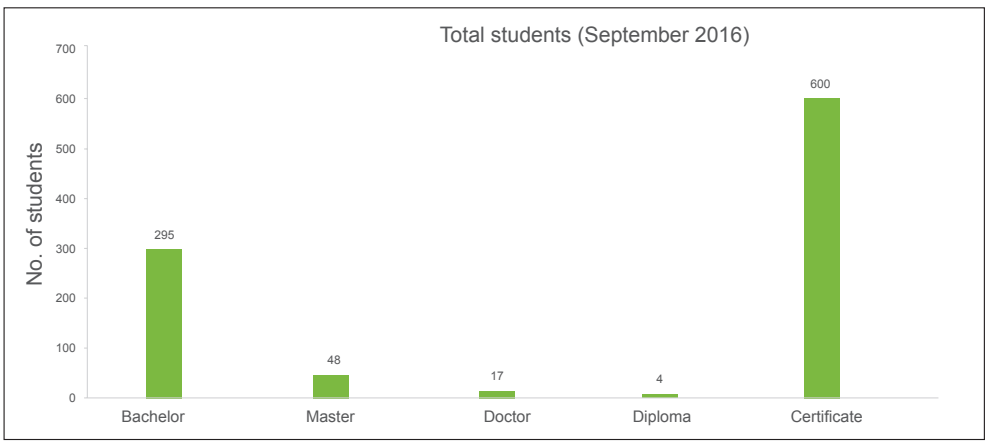

Figure 2. Total students enrolled in the last ten years in the 5 universities

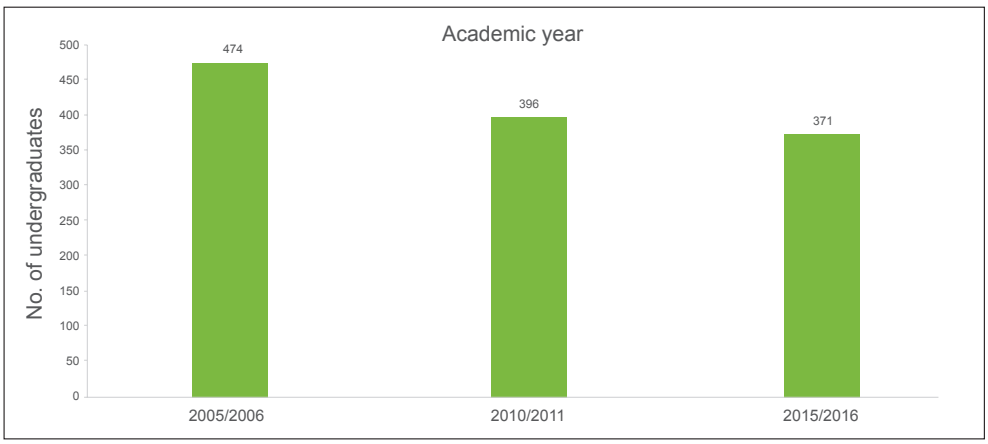

Figure 3. Number of undergraduate students in the 5 universities.

Gender ratio:

The gender ratio of undergraduate and graduate students varied considerably between levels and among universities (Table 1).

Table 1. Gender ratio of undergraduate and graduate students.

№	University	Department	Undergraduate		Graduate	
			Male	Female	Male	Female
1	National University of Mongolia (NUM)	Department of Environment, Forest Engineering (DEFE), NUM	15	21	4	11
2	Mongolian University of Science and Technology (MUST)	Department of Wood processing technology (DWPT), MUST	106	27	7	5
3	Mongolian University of Life Sciences (MULS)	Department of Ecology (DE), MULS	32	30	7	1
4	Darkhan branch, Mongolian University of Life Sciences (MULS)	Darkhan branch (Darkhan), MULS	16	5	0	0
5	International University of Ulaanbaatar (IUU)	Department of Horticulture (DH), IUU	25	18	8	7
Total			194	101	26	24

Employment:

Forestry employment in Mongolia is largely dominated by the public sector. Although the structure of the job market varies around economy, graduate degree holders have a better chance than bachelor degree holders to get professional positions (Table 2). Traditional forestry jobs dominate, such as positions in forest departments, forest enterprises, research, and education. Non-traditional jobs in the public sector, for example dealing with environmental issues, National Parks, community development and NGOs, are also available to foresters, and seem to be increasing in importance.

Table 2. Employment rate of Undergraduates and Graduates

Year	PhD		MSc		Bachelor	
	No. of graduates	Employment Number	No. of graduates	Employment Number	No. of undergraduates	No. of graduates
2015	2	2	8	8	168	118
2010	5	5	18	18	54	38
2005	3	3	6	6	59	40

Priority needs:

The priority needs most frequently reported from the 5 universities were:

- curriculum development and enable credit exchange mechanism between the universities;
- improvement of teaching and support staff via exchange programme of AP-FECM;
- improvement of facilities; and
- budget improvement.

Conclusion:

The forestry sector is changing in Mongolia because of recent socio-economic

changes and unstable government institutional structure and these changes are being incorporated in curricula. However, curriculum development remains the highest priority for forestry education institutions and demands further support from governments, donors and education specialists. Job opportunities for forestry graduates are still mostly in the public sector. However, if forests are to be well-managed, there will need to be more opportunities develop in the community-based forestry sector.

IX - UNIVERSITY OF CANTERBURY, NEW ZEALAND

BENCHMARKING NEW ZEALAND FORESTRY DEGREE PROGRAMMES

Dr. Bruce Manley, New Zealand School of Forestry, University of Canterbury

The New Zealand School of Forestry at the University of Canterbury offers the only professional forestry degree programmes in New Zealand. The Forestry Science programme commenced in 1970 and the Forest Engineering programme started in 1991. Although the focus of the degrees is on plantations, the aim is to provide graduates with the skills and technical expertise to manage any forest for a full range of uses.

Since we are the only professional forestry school in New Zealand we cannot benchmark our programme against other domestic degrees. Consequently we have to look internationally. Given that there are no comparable undergraduate programmes in Australia we have to look even further afield. Recent benchmarking exercises have included:

1. *Scope of degree programmes*

At UC we have two distinctive forestry programmes: the Bachelor of Forestry Science and the Bachelor of Engineering (i.e., Forest Engineering). In 2016 we undertook a review of the scope of these two programmes. As part of this review we compared our offerings with those of The University of British Columbia. We

focused on the UBC Bachelor of Science in Forestry which has two majors:

- Forest Resources Management
- Forest Operations

2. *Degree review*

Our degrees are reviewed every 5 years. The Forest Engineering programme is reviewed by the Institute of Professional Engineers of New Zealand while the Forestry Science programme is reviewed by an UC-appointed panel. The last review in 2013 was chaired by Professor Thom Erdle from the University of New Brunswick. As part of the review, the curriculum of the UC Bachelor of Forest Science degree was benchmarked against comparable degrees at:

- University of New Brunswick
- University of British Columbia
- Virginia Tech

Key differences were that the UC Bachelor of Forest Science programme had:

- Fewer foundation courses, notably less mathematics and English.
- Less ecology.
- More biometry.
- More forest management and economics.
- More wood and wood products.

It was concluded that these differences were appropriate given the New Zealand context and the focus of the UC Bachelor of Forest Science programme.

3. *Review of management*

In 2009 we reviewed whether we were adequately covering 'human factors' such as

Management, Leadership and Communication. A challenge was how to teach this material in a dynamic, stimulating way to students who have often had limited life experience. We compared what we were offering to programmes at:

- University of British Columbia
- University of Washington
- Agro Paris Tech ENGREF (French National Forestry School)
- University of Freiburg

The outcome of the review was that we extended our Forest Management course to include a Human Factors module. This course is taken by all Forestry Science and Forest Engineering undergraduates.

New Zealand is a small remote economy yet it has a dynamic and growing forestry sector. At the School of Forestry we have a policy of continuous improvement. We see this as necessary to meet the needs of domestic students, as well as an increasing number of international students seeking to learn from the New Zealand forestry experience. Benchmarking against international best practice has been vital in ensuring the relevance and quality of our degree programmes.

X - UNIVERSITY OF THE PHILIPPINES LOS BANÕS, PHILIPPINES

MASTER OF SCIENCE IN TROPICAL FOREST BIODIVERSITY AND CONSERVATION

Professor Willie Abasolo, College of Forestry and Natural Resources, UPLB

Rationale:

The University of the Philippines Los Banos (UPLB)-College of Forestry and Natural Resources, in collaboration with the Universiti Putra Malaysia (UPM) and Institut Pertanian Bogor (IPB), seeks to implement an international collaborative

programme leading to a M.Sc. in Tropical Forest Biodiversity and Conservation. This programme will focus on the opportunities, issues, and problems of biodiversity conservation in Southeast Asia and in other tropical economies. These 3 universities offer strong potential for implementing this programme given their academic credentials, laboratory and field facilities, and track record in research and development programmes related to biodiversity conservation in the region. In addition, the three economies where these universities are based are among the most biodiverse economies in the region, being the homes of numerous numbers of plant and animal species. Some of these species are currently under threat, and provide excellent opportunities for leaning biodiversity and conservation.

The proposed collaborative programme aims to produce competent and marketable professionals and experts in biodiversity and conservation who can: 1) develop theoretical understanding, research, analytical and communication skills and advanced knowledge on tropical biodiversity and conservation; 2) provide analytical and interdisciplinary understanding of policy and governance at the landscape level in which biodiversity operates; 3) foster a critical appreciation and understanding of the science underpinning biodiversity and its financial and economic sustainability and social links; and 4) apply effectively an integrated approach to resolving issues and problems involving the social, economic, and environmental dimensions of biodiversity and conservation, with a regional and transboundary perspective.

Programme Structure:

The M.Sc. in Tropical Biodiversity and Conservation is an integrated, world class two-year graduate degree programme. Students in this programme should acquire at least 24 credit units from at least two collaborating universities. The programme will commence in the first semester of the school year at a chosen university. The first year will cover basic courses. A joint summer module in the first year will dwell on fieldworks and practicum in one economy for five weeks. The joint summer module

will be conducted alternatively each year in a specified collaborating/host economy. The second year of the programme covers units that will include specialization courses within the areas of Biodiversity and Climate Change, Biodiversity and Sustainable Development, Biodiversity Policy and Governance, and Biodiversity Informatics. The second year ends with a 6-unit thesis.

Figure 1 shows that that the courses for the first year of the programme will be taken in the economy of application. During the first semester of the second year, students will take courses in another collaborating university/economy, and then go back to the economy of application (home economy) in the second semester for thesis writing.

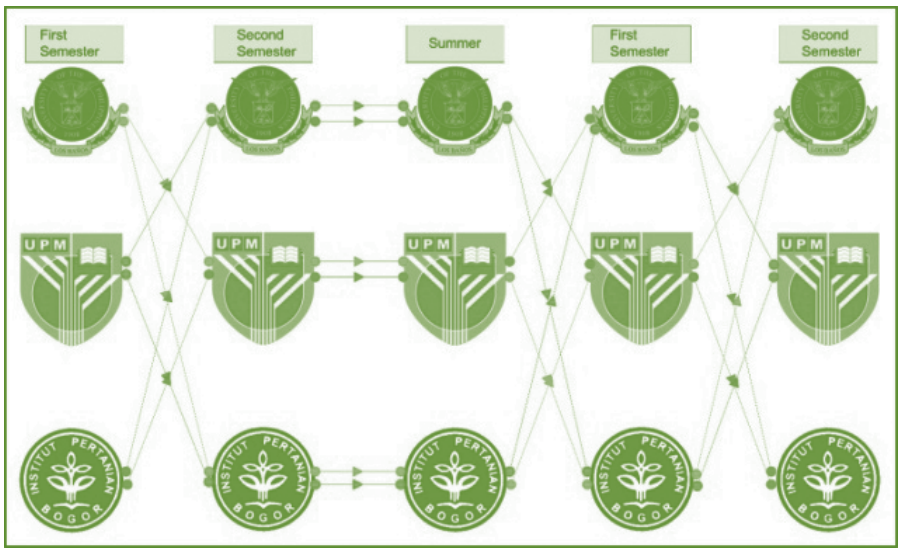

Figure 1. Programme structure of the MSc Biodiversity and Conservation

Admission Requirements:

To be eligible for the programme, the applicants should hold a B.Sc. degree, or its equivalent, with a good scholastic record. Should an applicant not have sufficient academic qualifications, he/she should possess evidence of adequate related research or work experience.

Programme Administration and Transition Mechanism:

A programme committee will be formed for each university and a programme coordinator for each university will be designated. The Programme Admissions Committee will be responsible for evaluating the applicants. A Programme Advisory Council may also be established with representatives from the three collaborating universities to provide direction and guidance in the implementation process.

Employment and Enrolment Projections:

The projected enrolment for the first three years of programme implementation is 20 students per economy per year. The projected employment of the graduates would be as experts in international organizations (i.e., GIZ, World Wildlife Fund, IUCN, ACB, Worldfish, and USAID), academia, private companies, and governments funding protected areas.

XI - KASETSART UNIVERSITY, THAILAND:

IMPORTANCE OF CAPACITY BUILDING IN FOREST GENETIC RESOURCES CONSERVATION IN ASIA AND PACIFIC

Asst. Prof. Damrong Pipatwattnakul, D.Sc., Faculty of Forestry, Kasetsart University

Source: Pipatwattanakul Damrong, N. Soonthorncharoernnon, S. Maelim, and S. Boonyern. 2010. Genetic Diversity Conservation of Cinnamomum porrectum (Roxb.) Kosterm (Theptharo): Genetic Resources. National Reserch Council of Thailand. Bangkok, Thailand.

Keywords: *Cinnamomom porrectum*, theptharo, plus tree selection, phytochemical analysis, safrole, genetic resource conservation, forestry education

The prime aim of this article is to highlight the importance of forestry education concerning forest genetic resources conservation and management. In the past three decades, the Thai government, as well as other Asian governments, has invested in research about flora and fauna biodiversity, including the status of biodiversity and the conservation measures. In 2009, the National Research Council of Thailand invested in research and development regarding medicinal plant diversity and its utilization, of which, genetic diversity conservation of *Cinnamomum porrectum* (Roxb.) Kosterm (Theptharo) was a part. This tree is a lesser known hardwood species, which provides multiple products including construction wood, handicraft, and medicinal uses. Currently, the species is close to disappearing from natural forests.

Based on a survey of good genetic material, conducted in 2010-11 and covering 17 districts in 7 southern provinces of Thailand (Phattalung, Songkhla, Pangnga, Phuket, Krabi, Trang, and Satun), there were 62 plus trees selected. The height of the plus tree ranged between 16.50 and 33.00 m with an average of 25.32 m. Commercial height ranged between 5.50 and 20.00 m with an average of 11.75 m. DBH ranged from 24.56 to 97.68 cm with an average of 47.25 cm. The biggest plus tree was 97.68 cm in DBH located in Trang Province. Phytochemical analysis indicated that the amount of extracted oil and its color differed among the selected trees. The percentage of extracted oil ranged between 0.92 and 9.32% v/w dry weight) with an average of 4.14% (v/w dry weight). Safrole was the main component in the extracted oil and it ranged between 128.26-266.23 ng/g per sample, with an average of 189.85 ng/g.

The research results confirmed the critical situation the declining amount of good genetic resources for Theptharo from its natural distribution range across the southern part of Thailand. The plus trees were mostly found in marginal land, remnant forests, and exploited areas. The main reason for the disappearance of Theptharo is its multiple uses, including high demand of the wood for handicraft and fresh stems for rubber and oil palm plantations. The continued illegal exploitation of Theptharo from the natural forest indicated a high risk of extinction

of the species from the southern part of Thailand. In addition, based on the variation found in phytochemistry study, further molecular genetic study through DNA analysis is needed to verify the variation in the extracted oil. With respect to gene conservation, a multiplication garden is the best means to secure the genetic resource conservation of this lesser known, multipurpose, tree species. Investing in expanding capacity, especially in the field of forest genetic conservation and biotechnology, is also an important strategy for the conservation of this tree species.

In Thailand, the forestry research is conducted by all organizations related to the forestry sector, especially the Faculty of Forestry, Kasetsart University, Royal Forest Department, and Department of National Park, Wildlife and Plant Conservation under the Ministry of Natural Resources and Environment. Forestry students comprise about 0.07 % of all higher education students in Thailand. Forestry students who major in forest genetics and biotechnology are very few compared to other forestry fields. At the Faculty of Forestry, Kasetsart University, for each group of Master students, there are approximately two who study forest genetics resource conservation, taxonomy, and molecular biotechnology. In addition, research facilities, such as molecular laboratories for DNA analysis, are scarce because they require advanced technologies and are very expensive. There has not been much investment in this field of education in Southeast Asia.

Figure 1. Up-rooted Theptharo stump in the backyard of farmer showing the high demand for its wood leading to extinction of the species.

Figure 2. Big stump of Theptharo in a rubber plantation showing the good genetic resources that once existed.

It is therefore important to consider capacity building in the field of forest genetic resources conservation, especially for lesser known species in Thailand and other AP Region economies. This type of study should be supported in the formal education system in order to increase capacity in the near future.

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